THE AMERICAN BREEDERS MAGAZINE

"When in any nation the standard of intellect and the number of intellectual men have increased, we may expect from the law of the deviation from an average that prodigies of genius will appear somewhat more frequently than before."—CHARLES DARWIN.

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A STUDY IN EUGENIC GENEALOGY

A. GARTLEY[a]

Honolulu, Hawaii

Eugenics is probably the most important and urgently necessary scientific work being pursued today as measured by its value both to the individual and to the state. This science was named by Sir Francis Galton, a cousin of Charles Darwin. Galton's lucid writings on the subject are fundamental and may almost be accepted as the eugenic creed. His definitions, "Eugenics is the study of the agencies under social control that may improve or impair the racial qualities of future generations either physically or mentally," and the more comprehensive one, "Eugenics is the science which deals with all influences that improve the inborn qualities of a race; also those that develop them to the utmost advantage," broadly set forth the scope of the work of the men and women who have undertaken to organize the science in its scientific and practical phases.

The science is new, and the subject has been misunderstood and misapprehended by some persons. The thought of a biological consideration of man—as a human animal—has been so abhorrent to the average mind that sociologists and biologists have lacked the courage or inclination to urge their theories or publish their truths, knowing that prejudices precluded rational and sensible consideration. Discussions of the relative importance of environment or heredity usually result whenever the subject is mentioned. But nurture and nature are very closely related and the eugenist proposes to unite the forces of the sociologists and biologists and increase the physical and mental soundness of man, and to raise to higher level the culture and the intelligence of the great citizen body. The his-

[a] Paper read before the Social Science Club of Honolulu, Hawaii, May, 1912. Mr. Gartley is Life Member A. B. A.

torian, the political economist, the sociologist and the philosopher have so far deduced no natural law nor suggested any practical rules of ethics by which this object might be obtained. The eugenist will endeavor to deduce such a law and prescribe methods of its application. Certainly this endeavor cannot be considered unworthy.

The law of Mendel has given us the key and it is hoped that great advance will be made through the study of precise data as to the unit characters in the germ plasm of man and the method of their transmission from generation to generation.

For centuries philosophers and thinkers, from Plato down, have recognized the inheritance of qualities from the individual but have usually only considered negative or recessive qualities and have warned against the inheritance of degeneration and defects. Galton in his book, *Hereditary Genius*, published in 1869, pointed out that mental qualities are inherited as are physical qualities and that it is both possible and desirable to improve the human race. Years of study and patient investigation have advanced the subject from an academic to a working basis. The publication of Galton's address "Eugenics, Its Definition, Scope and Aims" met with an enthusiastic response, and the work as outlined is now being actively advanced in Great Britain under the direction of Prof. Karl Pearson at the Eugenics Laboratory of the University College, London, which was established in 1905 by Sir Francis Galton, and was made his residuary legatee at his death in 1911. In the United States a beginning in the organization of eugenics study and propaganda have also been made and the Eugenics Record Office was established at Cold Spring Harbor, Long Island, N. Y., October, 1910, in connection with the Eugenics Section of the American Breeders Association and the collection and study of records and data is now well under way.

Pearson has stated three fundamental biological ideas. First, "That the relative weight of nature and nurture must not *a priori* be assumed but must be scientifically measured; and thus far our experience is that nature dominates nurture and that inheritance is more vital than environment." Second, "That there exists no demonstrable inheritance of acquired characters. Environment modifies the characters of the existing generation, but does not (often) modify the germ plasms from which the next generation springs. At most, environment can permit a selection as to which germ plasms, among the many provided, shall be potential and which shall remain latent." Third, "That all human qualities are inherited in a marked

and probably equal degree." If these ideas are substantially true the theoretical side is much simplified and "selection of parentage is the sole effective process known to science by which a race can continuously progress."

Studies in heredity indicate that every man is an aggregation of large numbers of certain physical and mental characters, and that these characters are not reducible to simpler forms. They are therefore called unit characters; and they are transmitted through the germ plasm as separate units. Furthermore, the inheritance of these unit characters seems to follow Mendel's law and the presence or absence of desirable or undesirable characteristics marks the differences in the character of the men and women about us. It has been convincingly demonstrated that a unit character, absent in both parents, will also be absent in all their offspring, or, in Mendelian terms, when a recessive mates with a recessive, only recessives result. This has been most strikingly shown in the results of the

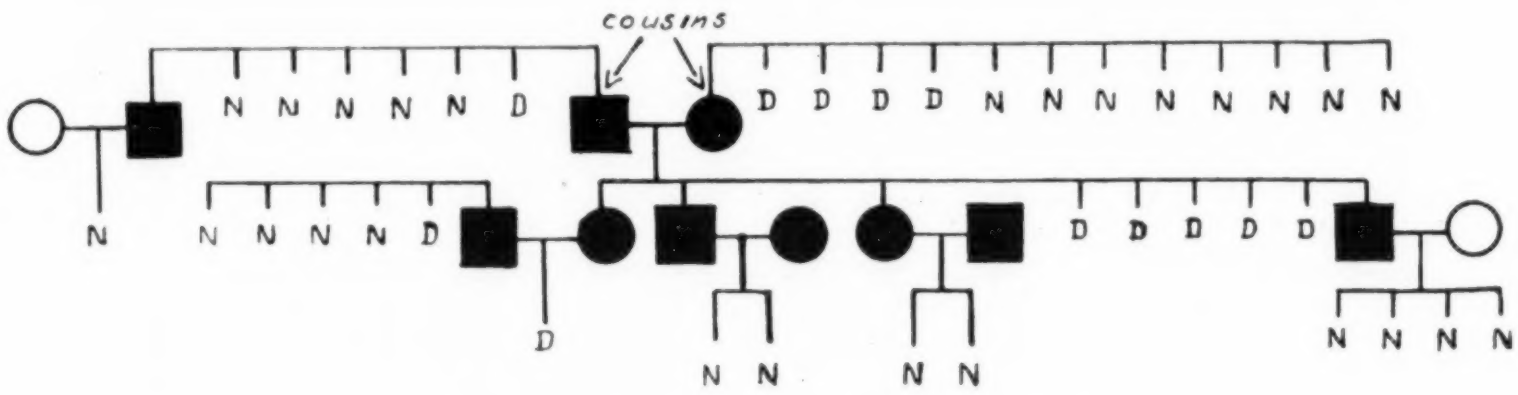


FIG. 1.—TRANSMISSION OF DEAF-MUTISM

In this as well as the following heredity charts the squares represent male members of families, the disks female members. Squares or disks shaded black represent individuals possessing the character under consideration, white symbols, normal ones. Where sex is unknown the letter N stands for normal, D, deaf-mute. "Note the fraternity of deaf-mutes derived from the central mating of cousins. Most of those who outmarried, even though their consorts were deaf, had hearing children." (After Davenport, *Heredity in Relation to Eugenics*, p. 127.)

selective mating of the feeble-minded, and never has a normal child been known to result from the union of two feeble-minded parents.

As another example, vigor and virtue seem to be dominant, and weakness and vice to be recessive. When a dominant character mates with a recessive the children will all have the dominant character but possibly in a dilute condition; the recessive character, however, remains latent, and will reappear one-fourth as often as the dominant.

In order to show more clearly the principles outlined above, three heredity charts are shown and these, selected out of several thousands already plotted, are quite convincing and should furnish material for thought and study.

The first chart shows the inheritance of deaf-mutism to be complete by the marriage of cousins, in families or strains possessing this defect, when the defect is produced no doubt from the same cause. It will be noted that the out-mating of this defective strain with deaf-mutes or other strains produces normal children. This chart emphasizes the necessity of care in consanguineous matings when defects are known to exist in the strain. There is also danger in such matings, of the reappearance of latent defects, after having been absent from one or more generations. This chart shows the inheritance of only one physical defect, but many other physical and mental defects show a similar method of inheritance and follow the Mendelian law.

What are perhaps the most remarkable and most convincing results have been obtained from the study and the charting of heredity

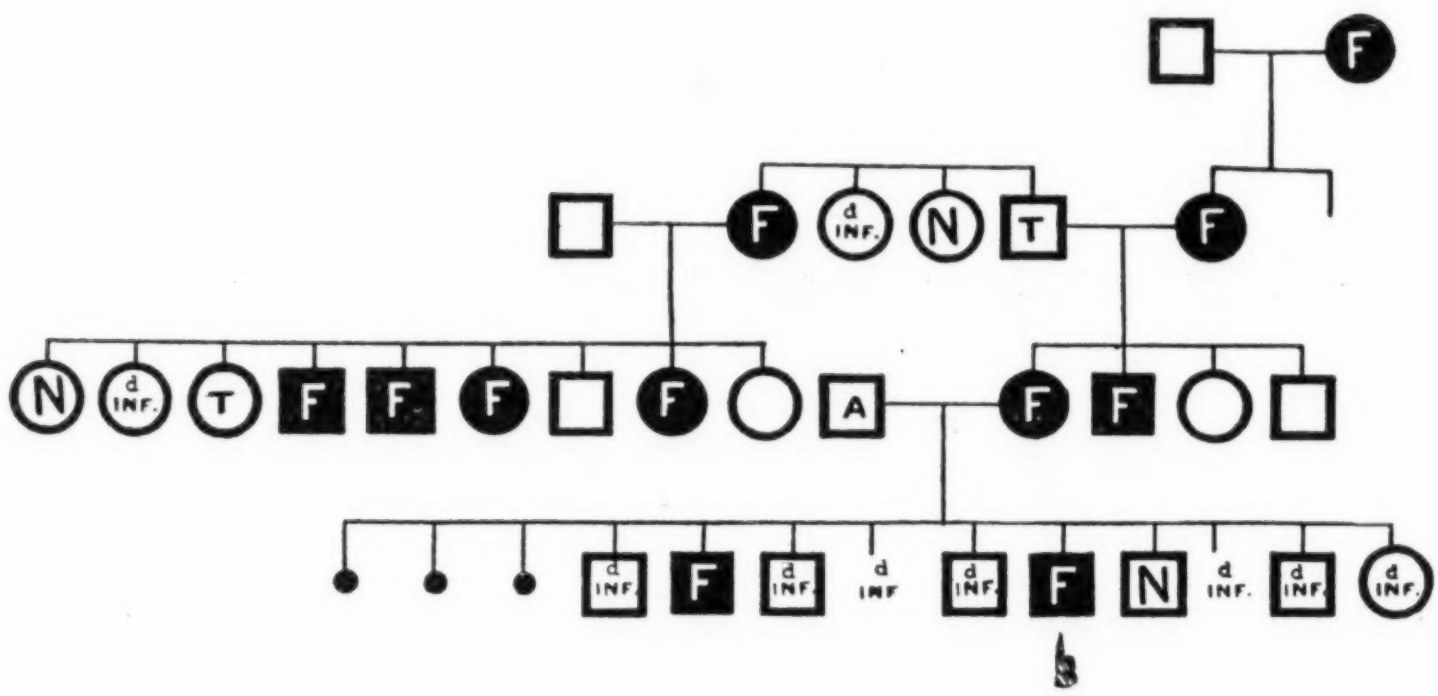


FIG. 2—HEREDITY CHART SHOWING TRANSMISSION OF FEEBLE-MINDEDNESS THROUGH THREE GENERATIONS.

(Courtesy of Dr. H. H. Goddard, Vineland, N. J.)

of feeble-mindedness and are especially shown by the work of Dr. Henry H. Goddard of Vineland, N. J., in charge of the Institution for Feeble-Minded. One chart, showing the transmission of feeble-mindedness, is worthy of special study. Concerning the history of the case Dr. Goddard says:[b]

> This chart is particularly interesting as showing the mental defect running through four generations, and through the mother's family in three of these, although there is defect on the father's side also in the third generation.

[b] *American Breeders Magazine*, vol. 1, no. 3, p. 176.

The chart, figure 3, brings out the unfailing transmissible of feeble-mindedness with peculiar force. The central figure is a woman who had three husbands, and the social experiment, charted above, was as follows:

This woman was a handsome girl, apparently having inherited some refinement from her mother, although her father was a feeble-minded alcoholic brute. Somewhere about the age of seventeen or eighteen she went out to do housework in a family in one of the towns of this state (New Jersey). She soon became the mother of an illegitimate child. It was born in an almhouse to which she fled after she had been discharged from the house where she had been at work. After this, charitably disposed people tried to do what they could for her, giving her a home for herself and her child in return for the work which she could do. However, she soon appeared in the same condition.

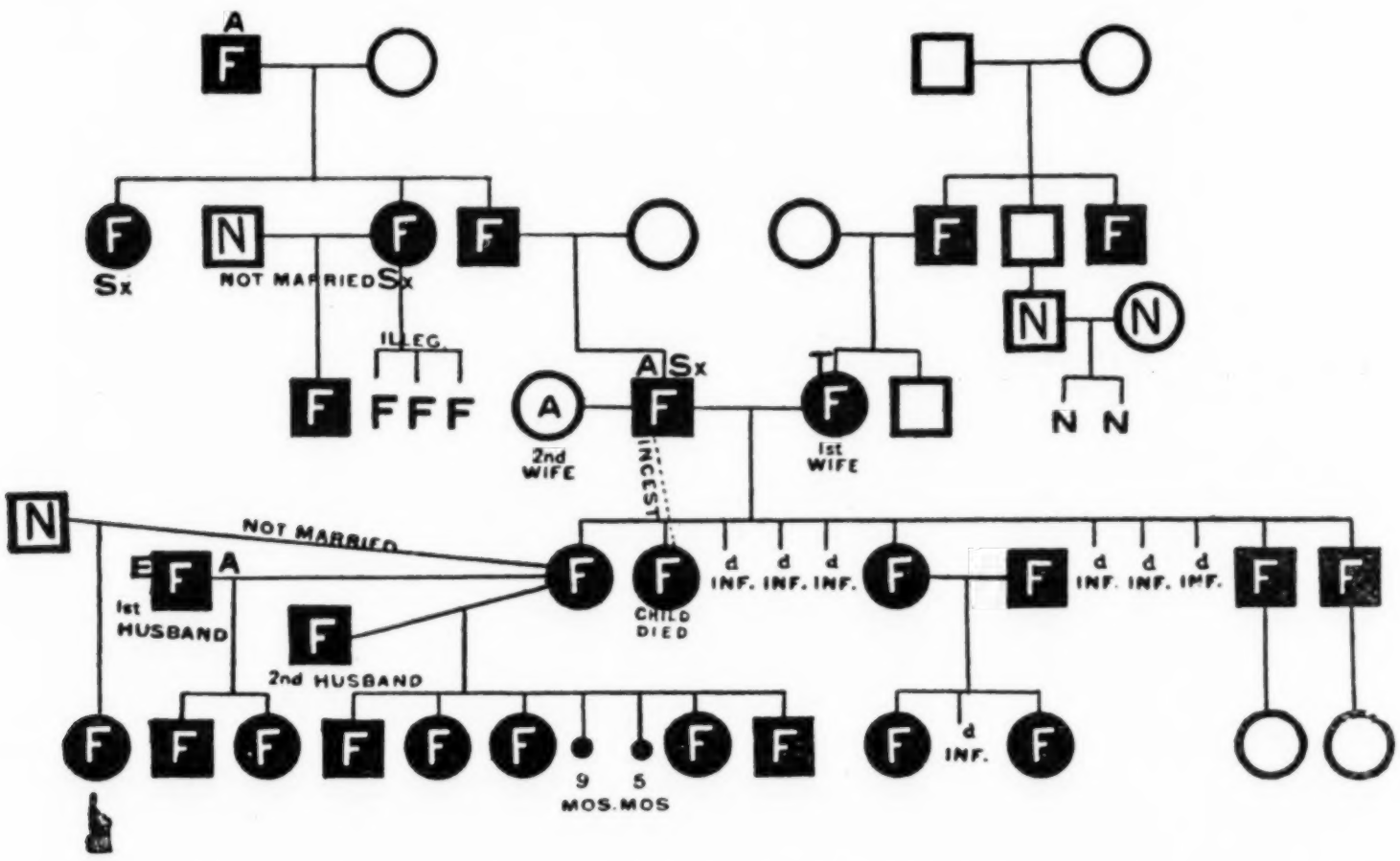


FIG. 3—HEREDITY CHART SHOWING TRANSMISSION OF FEEBLE-MINDEDNESS THROUGH FOUR GENERATIONS

(Courtesy of Dr. H. H. Goddard, Vineland, N. J.)

An effort was then made to discover the father of this second child, and when he was found to be a drunken, feeble-minded epileptic living in the neighborhood, in order to save the legitimacy of the child, her friends saw to it that a marriage ceremony took place. Later another feeble-minded child was born to them. Then the whole family secured a home with an unmarried farmer in the neighborhood. They lived there together until another child was forthcoming which the husband refused to own. When finally the farmer acknowledged this child to be his, the same good friends interfered, went into the courts and procured a divorce from the husband, and had the woman married to the father of the expected fourth child. This proved to be feeble-minded, and they have had four other feeble-minded children, making eight

in all, born of this woman. There have also been one child still-born and one miscarriage.

As will be seen from the chart, this woman had four feeble-minded brothers and sisters. These are all married and have children. The older of the two sisters had a child by her own father, when she was thirteen years old. The child died at about six years of age. This woman has since married. The two brothers have each at least one child whose mental condition is known. The other sister married a feeble-minded man and had three children. Two of these are feeble-minded and the other died in infancy. There were six other brothers and sisters that died in infancy.

No record can show more black symbols, or in other words, transmission of defectiveness, than that of the last two generations, where all known members of the strain are feeble-minded.

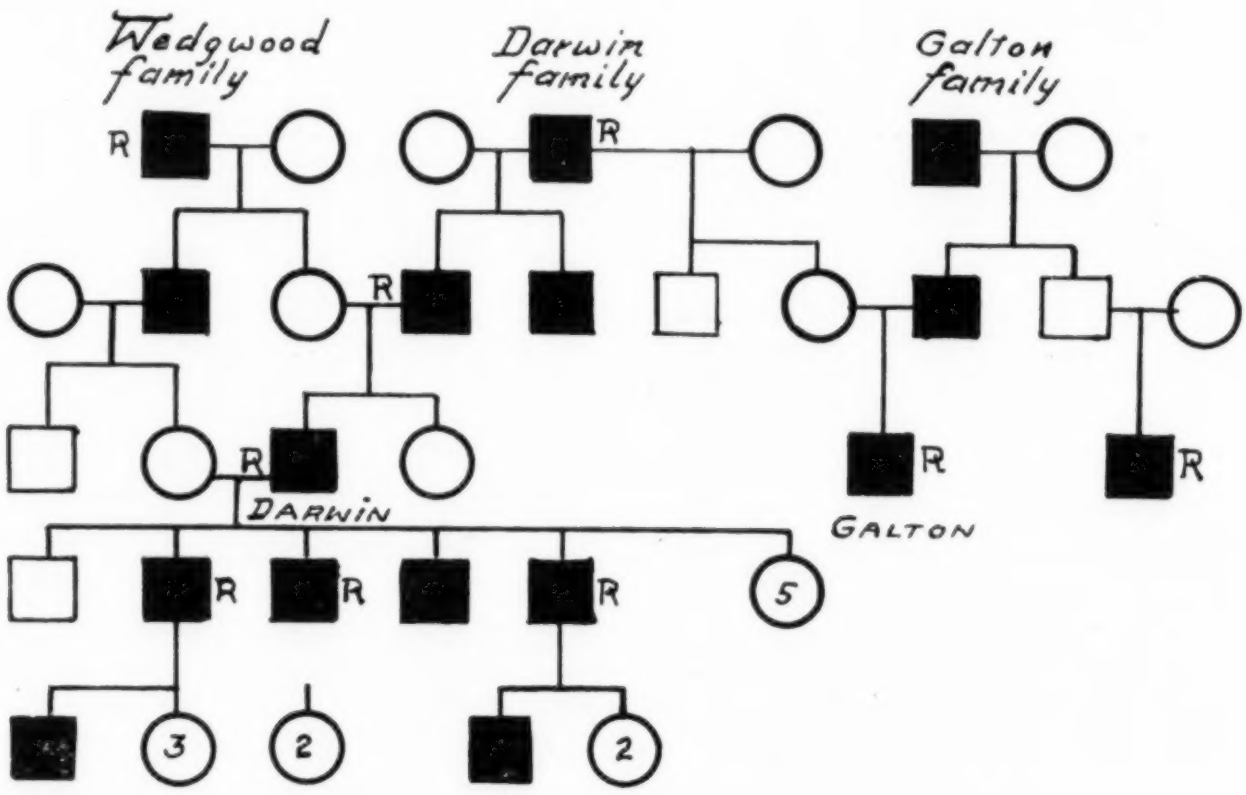


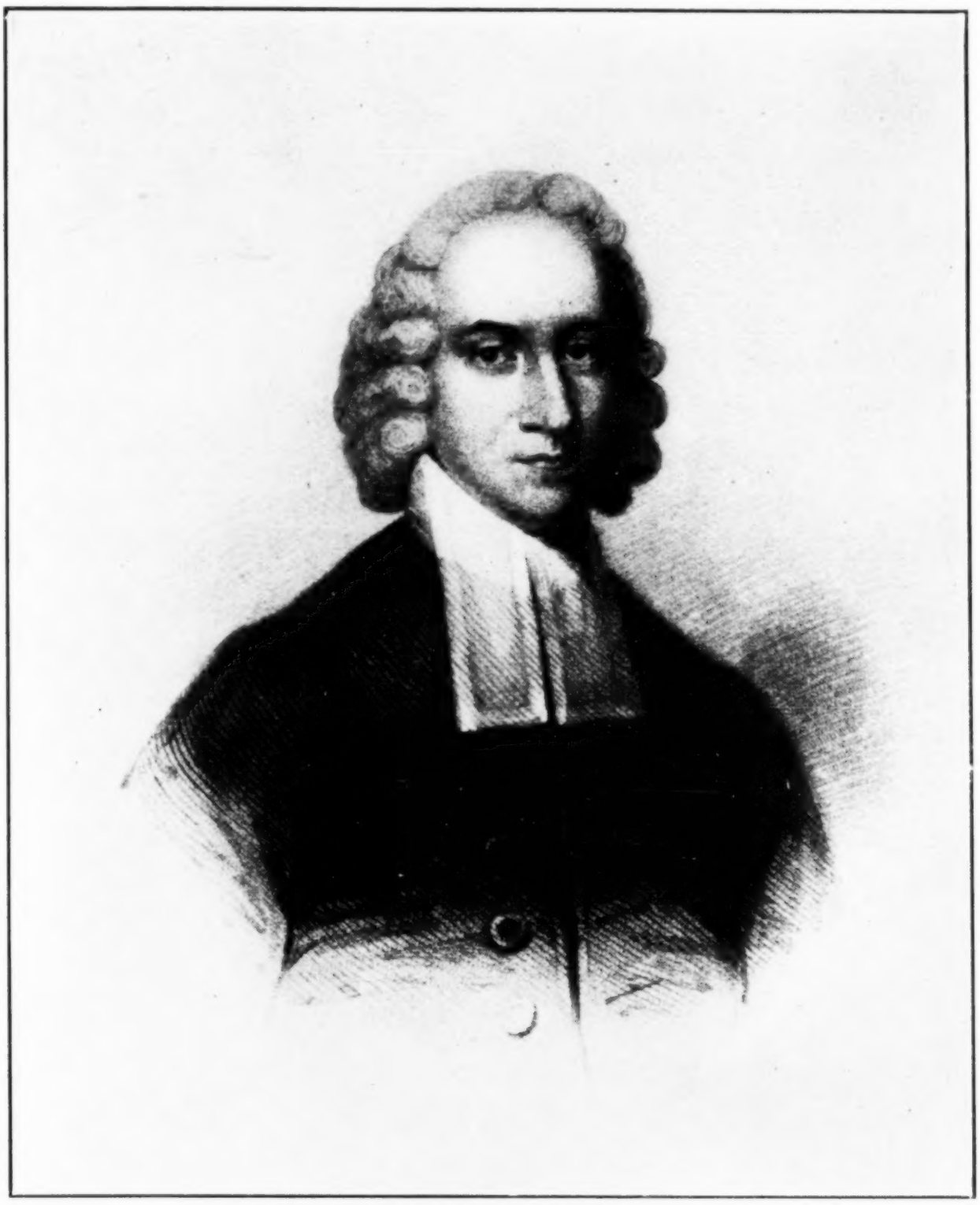
FIG. 4—GENETIC CHART OF THREE FAMILIES POSSESSING MARKED ABILITY

Black symbol signifies that the person which it represents in the kinship, possessed scientific ability. The letter R on side of symbol denotes that in addition the person is a Fellow of the Royal Society. Numbers within symbols indicate other children in childship not charted.

It will be noted that the two feeble-minded brothers of the second generation (shown on the right of the chart) had one normal brother whose normal son, mated to a normal woman, produced two normal children.

But there is a bright side as well and Galton's efforts were largely positive; that is he endeavored to demonstrate the inheritance of mental capacity and the possibility of improving the human race. An abbreviated record of his own family including the Wedgwood

and Darwin families is pregnant with data in support of the conclusion that these strains carry the potential germ plasm of hereditary genius, great mental capacity, powerful physique, and longevity. There can be no question that "Inhibitions responsible for honesty and dishonesty, morality and licentiousness, temperance and drunkenness, as well as strength and defectiveness of mind, talents for music, for poetry, for oratory, for mechanical invention and the

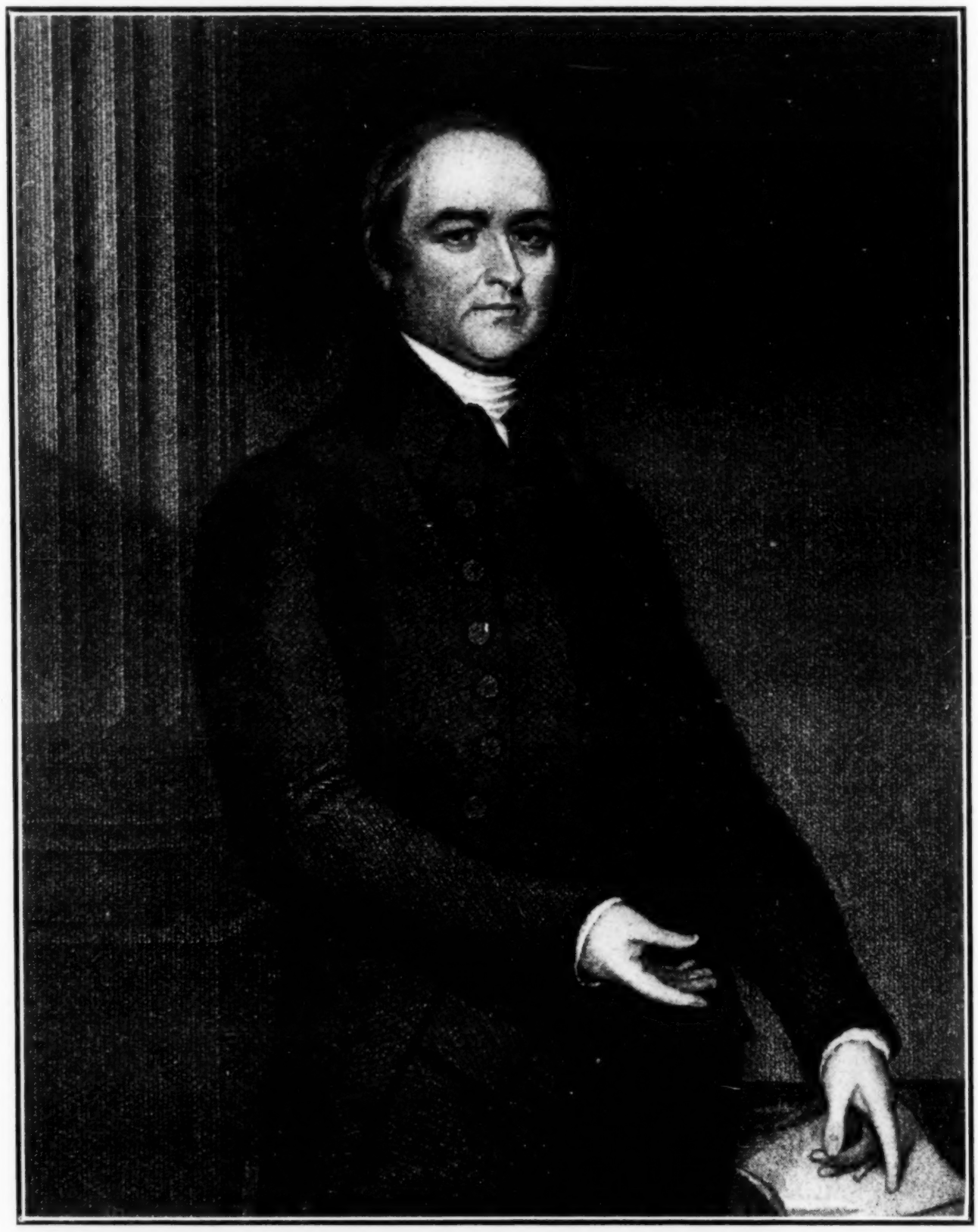


JONATHAN EDWARDS

absence of these talents" are wholly or in part "subject to the Mendelian laws of segregation, dominance, and recombination." What we want is a nation of individuals possessing physical and mental capacity, soundness, aggressiveness, concentration, and sympathy and a germ plasm transmitting these qualities. Unfortunately these qualities are only occasionally combined in one individual, but usually

appear separately. The production of a race of men and women, a great majority of whom shall possess these qualities, will be the next step in human achievement.

The value of the individual possessing a potentially strong plasm is excellently illustrated by Davenport[c] who cites one of our best known genetic records, namely, that of Elizabeth Tuttle.



TIMOTHY DWIGHT, S.T.D., L.L.D.

From two English parents, sire at least remotely descended from royalty, was born in Massachusetts, Elizabeth Tuttle. She developed into a woman of great beauty, of tall and commanding appearance, striking carriage, of strong will, extreme intellectual vigor, of mental grasp akin to rapacity, attracting by not a few magnetic traits, but repelling when she evinced an extraordinary deficiency of moral sense.

[c] *Heredity in Relation to Eugenics*, Davenport, p. 225.

On November 19, 1667, she married Richard Edwards of Hartford, Connecticut, a lawyer of high repute and great erudition. Like his wife he was very tall and as they both walked the Hartford streets their appearance invited the eyes and the admiration of all. In 1691 Mr. Edwards was divorced from his wife on the grounds of her adultery and other immoralities. The evil trait was in the blood, for one of her sisters murdered her own son and a brother murdered his own sister. After his divorce Mr. Edwards re-married and had five sons and a daughter by Mary Talcott, a mediocre woman, average in talent and character and ordinary in appearance. None of Mary Talcott's progeny arose above mediocrity and their descendents gained no abiding reputation.

Of Elizabeth Tuttle and Richard Edwards, the only son was Timothy Edwards who graduated from Harvard College in 1691, gaining simultaneously the two degrees of Bachelor of Arts and Master of Arts, a very exceptional feat. He was pastor of the church in East Windsor, Connecticut, for fifty-nine years. Of eleven children the only son was Jonathan Edwards, one of the world's great intellects, preëminent as a divine and theologian, President of Princeton College. Of the descendants of Jonathan Edwards much has been written; a brief catalogue must suffice: Jonathan Edwards Junior, President of Union College; Timothy Dwight, President of Yale; Sereno Edwards Dwight; President of Hamilton College; Theodore Dwight Woolsey, for twenty-five years President of Yale College; Sarah, wife of Tapping Reeve, founder of Litchfield law school, herself no mean lawyer; Daniel Tyler, a general of the Civil War, and founder of the iron industries of North Alabama; Timothy Dwight the second, President of Yale University from 1886 to 1898; Theodore William Dwight, founder and for thirty-three years warden of Columbia Law School; Henrietta Frances, wife of Eli Whitney, inventor of the cotton-gin, who, burning the midnight oil by the side of her ingenious husband, helped him to his enduring fame; Merrill Edwards Gates, President of Amherst College; Catherine Maria Sedgwick, of graceful pen; Charles Sedgwick Minot, authority on biology and embryology in the Harvard Medical school; and Winston Churchill, the author of *Coniston*. These constitute a glorious galaxy of America's great educators, students, and moral leaders of the republic.

(TO BE CONTINUED)

FIRST REPORT OF THE COMMITTEE ON IMMIGRATION OF THE EUGENICS SECTION

ALEXANDER E. CANCE; JAMES A. FIELD; ROBERT DE C. WARD;
PRESCOTT F. HALL, Secretary

At a meeting of the Eugenics Section of the American Breeders Association, held at Washington, December 30, 1911, the following resolution was adopted:

RESOLVED: That the Eugenics Section organize a permanent committee on immigration, with authority to coöperate with similar committees [illegible here),

organizations in securing laws which will be more effective in securing immigrants which bring good health and normal and superior heredity to this country.

In accordance with this vote a committee on immigration was organized as follows, the chairmanship of it being left in abeyance for the present:

Prof. Franz Boas, Columbia University, New York City; Dr. Alexander E. Cance, Amherst, Mass.; Prof. James A. Field, University of Chicago; Prescott F. Hall, Boston, Mass., *Secretary;* Prof. Robert DeC. Ward, Harvard University, Cambridge, Mass.

The first meeting of the committee was held March 26, 1912, in Boston, Messrs. Field, Hall and Ward being present. There was a discussion of the situation, and the committee felt that the first year of its work should be devoted to a general survey of the needs and possibilities of eugenic work in immigration matters, rather than to starting any original investigations.

The starting point for eugenic work in immigration seems to be to ascertain in what particulars the present law governing the admission of aliens are defective or inadequate, and whether the administration of those laws is or can be effective to shut out those elements of immigration which are dangerous to the well being of the nation for eugenic reasons. The need for information on these points is the greater as our citizens generally know very little of what goes on at the ports of entry. Furthermore what is printed in our newspapers regarding administration methods is often false or misleading. Your committee, therefore, consulted numerous immigration officials, especially in New York and Boston; visited Ellis Island; talked with Commissioner Williams and with New York State officials, and went over a large number of official reports regarding immigration and the methods of inspecting and deporting aliens.

As a result of this work, your committee finds that not only are the immigration laws inadequate to effect the exclusion of the unfit, but that the inspection is not as thorough as it ought to be, owing to inadequate facilities, an insufficient number of inspectors, and the frequent arrival of very large numbers of aliens at one time. It further finds that in some cases the law is actually violated, both in the spirit and in the letter.

A specific instance of the kind of thing that is now going on is the case of Pace Chosen, a Hebrew boy arriving from Russia, February ex[illegible]5, 1912. The boy was certified as an imbecile by the examining [illegible]. This certificate was confirmed subsequently by three dif-

[illegible] *Heredity in Relation*

ferent medical boards summoned to pass on the case, and his condition was admitted by his family. Sect. 2, of the immigration act and the case of Zatarian V. Billings, 204 U. S. 170, make it clear that the boy was an alien and that his exclusion was mandatory. Intercession was made, however, in his behalf by a Jewish organization in Washington, and finally Secretary Nagel ordered him landed on bond. In the similar case of Mosche Rabinowitz, landed November 13, 1909, the alien immediately became a public charge as an inmate of an insane asylum in Missouri; and could not be deported, because having been landed, he acquired citizenship through the citizenship of his father.

These two instances show that even where the inspection is thorough, unfit aliens are occasionally admitted, owing to alleged motives of humanity or personal influence with the Department. That, whatever the cause may be, large numbers of unfit persons are landed every year is made clear by the experience of New York State. According to Goodwin Brown, Special Counsel to the New York State Commission in Lunacy, the state has suffered an expense of at least $25,000,000, to say nothing of the damage to the public health, through the admission of defective aliens. By the last available census, New York State's foreign born population is less than 30 per cent, while the foreign born population of the insane hospitals is over 50 per cent, reaching 65 per cent in New York City. In Bellevue Hospital in 1908, 84 per cent were of foreign parentage.

Perhaps of even greater menace to the public health than the alien insane, are the alien feeble-minded. The former are, at least to some extent, segregated, and prevented from breeding; the latter, except in one or two states are not segregated sufficiently to remove the menace of their presence. Feeble-mindedness is peculiarly a defect where family histories become important. In his report for 1911, Hon. William Williams, Commissioner of Immigration at New York, has this to say about this class (Report of the Commissioner-General, p. 147):

> I desire to add a few words on the subject of "feeble-minded" immigrants. Our attention is from time to time called to the number of feeble-minded alien children in the public schools of New York, many of whom have passed through Ellis Island. One reason why they are not excluded is, as pointed out in my last annual report, lack of time and facilities for thorough examination as to mental condition. Another is that while idiocy and imbecility can usually be recognized even in infancy, yet feeble-mindedness can rarely be discovered so early, and is usually recognized only as the child approaches the school age. As to children under 5 (and a great many such alien children come here),

it is probably correct to say that nothing short of an inquiry into their heredity will enable the government to determine whether or not they are feeble-minded, and since no such inquiry is now made, the law as to the exclusion of young feeble-minded children is virtually a dead letter, and the Ellis Island authorities have not the means at their command to vitalize it. Not only is a feeble-minded person likely to become a charge upon the community, but such an individual may leave feeble-minded descendants, and so start a vicious strain that will lead to misery and loss in future generations and influence unfavorably the characters and lives of hundreds of persons. A great majority of feeble-minded children are born of parents who have suffered from feeble-mindedness, insanity or epilepsy. A large proportion of the inmates of Elmira reformatory are feeble-minded. The feeble-minded contribute largely to the criminal class and are often the cause of incendiary fires. At a time when the subject of feeble-mindedness is becoming more and more important in civilized countries and the nature and bearings of this taint are being carefully studied by scientists the government would seem called upon to make far greater efforts than it does to prevent the landing of feeble-minded immigrants.

From a eugenic standpoint, however, the danger from classifiable defectives, great as this is, is probably less than the danger from the much larger class of aliens who are below the mental and physical average of their own countries and cannot fail to lower the average here. To quote again from the report of Commissioner Williams (Report of the Commissioner-General for 1909, p. 133):

> I have already adverted to the easy-going character of our exclusion laws and stated that even their strict enforcement keeps out only the very bad elements of foreign countries. Between these elements and those that are a real benefit to the country (as so many of our immigrants are) there lies a class who may be quite able to earn a living here, but who in doing so tend to pull down our standards of living. . . . . I wish merely to emphasize what must be known to every thinking person, that [this class] is coming here in considerable numbers and that we are making no effort to exclude it.

In 1907, a clause was added to the immigration law debarring those certified by a surgeon as being mentally or physically defective, such defect being likely to affect their ability to earn a living. The object of those supporting this amendment was to have defectives absolutely barred upon the surgeon's certificate; but it has been construed so as to make the certificate merely one piece of evidence to be considered by the board of special inquiry sitting on the case, and so virtually reduces the eugenic question to the economic one whether the alien is liable to become a public charge.

This construction is the more serious on account of a ruling of the Secretary of Commerce and Labor, made February 8, 1912, commonly known as "Decision No. 120." The law says (Sect. 20)

that an alien who becomes a public charge "from causes existing prior to landing" may be deported within three years from the date of his entry. In this case a girl who entered in 1909 became an inmate of a New York insane hospital in 1911. The New York State Board of Alienists certified that the causes of insanity were constitutional psychopathic tendencies and mental instability, and that these causes existed prior to landing. A surgeon of the Marine Hospital Service gave a similar certificate. The patient claimed a felonious assault in 1911 as the cause of her condition. The Secretary ruled that it had not been shown that the causes named by the surgeons were the sole causes of the insanity; and that the department officials, though possessing no medical knowledge, could revise the opinion of medical experts. The New York State Board of Alienists vigorously protested, quoting numerous medical authorities to show that an external cause, like the alleged assault, could not be the cause of the patient's condition; but deportation was refused, and the decision still stands.

This decision as to deportation shows that it is even more important than before to make examination at the time of entry thorough. It also shows that if medical experts are of any value at all, the law should be altered so as to make the decision of the medical officer, or of a medical board on appeal, final. As a concrete illustration of the present condition of things, it appears that in 1910 at one of our largest ports, of 1483 aliens certified by the surgeons for serious mental or physical defects, 1370 were landed. That such persons do not delay in becoming public charges is shown by the experience of Massachusetts in 1910.[a]

Class.	Total number.	Less than one year in United States.
Insanity	99	49
Tuberculosis	31	31
Typhoid	22	21
Total	152	101

Attention should be called in this connection to another most dangerous decision made by the Secretary of Commerce and Labor July 12, 1912, in the case of Riwke Polayes. This decision holds, in effect, that minor foreign born children of naturalized citizens are free from the operation of the immigration laws. In other words, an alien may come here, take out naturalization papers, and bring

[a] Report of Surgeon of Public Health Service at Boston, for 1910.

in his children, even though they are idiotic, insane, tuberculous, leprous, or otherwise dangerously diseased. Of course, in many cases such children must at once be placed in institutions in order to protect the public health, and, in many other cases, will soon become public charges; while the danger of epidemics and general infection will be greatly increased. This decision reverses the practice of the Immigration Bureau since 1882, and is, we believe, in direct conflict with the decision of the Supreme Court above referred to.

The commissioners at the various ports are undoubtedly doing the best they can; but when 5000 aliens arrive in one day at Ellis Island, as not infrequently happens, it is obvious that either they must be detained for a longer time or more surgeons must be furnished in order to have an adequate medical examination. In mental cases especially, it may be necessary to have doubtful cases under examination for a longer time; but the saving of expense to the state and municipal authorities as well as the protection of the public health demand this.

Not only should Decision No. 120 be reversed, but the present period of deportation should be extended to at least five years. There is no time limit on the deportation of immoral persons. Why should there be on other defectives and delinquents? Further, it seems to your committee that instead of the burden of proof being placed as now upon the government to show that the alien became a public charge from causes arising prior to landing, the burden should be upon the alien to show that the cause of his becoming a public charge arose subsequent to his landing. The extension of the period to five years has been recommended as to major criminals by the Immigration Commission.

Under the present law transportation companies are liable to a fine of $100 for bringing any idiot, imbecile, epileptic, or a person having tuberculosis or a loathsome or dangerous contagious disease, if the alien's condition could have been detected on embarkation (Sec. 9). Although this provision has been in force several years, the fines collected in 1911 amounted to $24,600, showing that the companies are willing to take considerable risks. It has been found that they sometimes protect themselves by requiring a deposit of the amount of the fine. The Immigration Commission recommends increasing the fine to a maximum of $500, leaving the minimum as at present. Your committee endorses this recommendation.

Your committee has had access to the results of a questionnaire sent in 1911 to all living graduates of the Harvard Medical School.

Of the replies received all but five favored a more rigid inspection of immigrants and the application of more thorough physical and mental tests. Many doctors having experience in immigrant localities wrote strongly to the effect that the present inspection is not sufficient.

Your committee recommends the adoption of the following resolutions by the Eugenics Section for transmission to and adoption by the American Breeders Association; and further recommends that the Secretary of the Association send copies of these resolutions to the President of the United States, and the members of the Immigration Committees of the Senate and House of Representatives:

WHEREAS it appears that in spite of existing immigration legislation, and the faithful enforcement of such legislation by the Commissioners of Immigration at New York and other ports, many mentally and physically defective aliens obtain entrance to this country, to the detriment of the public health, and of the eugenic future of the race, and to the burdening of the public treasury,

RESOLVED: That in the opinion of this Association the decision known as "Decision No. 120" and the decision that minor children of naturalized aliens are exempt from the operation of the immigration laws should be at once reversed.

RESOLVED: That the period of deportation (except in the case of immoral persons, as to whom there is and should be no limit of time) should be extended to five years, and that the burden of proof should be changed so that the alien must show that the cause of his becoming a public charge arose subsequent to landing.

RESOLVED: That the fines imposed on transportation companies for bringing inadmissible aliens be made to cover also the bringing of insane persons, and that the amount be changed to not less than $100 nor more than $500 in each case.

RESOLVED: That enlarged facilities should be given the Commissioners of Immigration at the various ports, especially at Ellis Island, in order that a more thorough examination of aliens may be possible; and that a sufficient number of expert alienists should be appointed to examine mental cases.

Professor Boas dissents from the conclusions and recommendations of the Committee.

THE EUGENICAL ASPECT OF VENEREAL DISEASE

H. E. JORDAN[a]

University, Virginia

The most insistent reason for the eradication of the venereal diseases, namely, the eugenic, does not seem to have received adequate popular emphasis. Public sentiment is gradually being evolved, and legislation framed, to protect the race against the reproductive libertinism of the pauper, the criminal, and the idiot. Also, society is now quite generally fully protected against such serious contagious diseases as diphtheria, scarlet-fever, and small-pox. But nothing short of criminal negligence still prevails almost universally in the matter of protecting both the present generation and the future race against the dangers of syphilis and gonorrhoea. There exists not a single valid argument against the legal registration, isolation, detention, and prohibition of marriage of certain classes of patients. It is the purpose of this note to present what appear irrefutable arguments for the statutory limitation of venereals, to attempt to discover the speciousness of the arguments sometimes urged against legal restrictive measures, and to evoke discussion of this matter so supremely significant from the standpoint of the future race.

A serious consideration of the widespread prevalency and racial harm of the "social diseases," leaves no shadow of doubt that they are fundamental and extremely pernicious anti-eugenic factors. Attention to other eugenic endeavors will be of little avail unless we include in our program a crusade to the death upon venereal disease. No interest can be paramount to that of the race. There can be no loftier motive than to aid in the production and universal establishment of the highest type of physical, moral, and intellectual man, within the limits of human protoplasm. This being granted, all questions of practicality and constitutionality must give way to *right*. Nothing can be more practical than the elimination of economic and racial inefficiency. When we agree that it is right to eradicate venereal diseases—and no one will seriously argue the point—then it would seem that those measures which will most speedily effect this condition are the most justifiable. The personal liberty and individual comfort of the unfortunates need, and should, be regarded

[a] Chairman of the Eugenics Section of the American Association for the Study and Prevention of Infant Mortality. In slightly altered and amplified form this paper was presented at the Cleveland meeting, October 3, 1912.

only to an extent not incompatible with full protection to society and the race. Society surely has a right, even an obligation, to guard its well-being against destructive and deleterious agencies.

Under the heading Prudery, in an article on "The Sterilization of Criminals and Defectives," Dr. John N. Hurty, State Health Commissioner of Indiana, writes thus:

> What are we doing for posterity in the protection of human blood and human health? We are permitting thousands, tens of thousands, hundreds of thousands of human beings to marry and reproduce their own kind, when at the time of their marriage they are deviates or they are afflicted with unmentionable diseases which if they will not directly cause death, will visit themselves to the third and fourth generation in the forms of blindness, bone disease, insanity, imbecility and all varieties of tuberculosis and cause nervous wrecks, moral degenerates, and perverts. We are doing this because we will not stop it, not because we cannot. 'Tis puling, pursy prudery which prevents. We are filling our almshouses, hospitals, jails, penitentiaries and homes for the morally and physically unfortunate, by our refusal to meet the social question, the sex problem, the prevention of the procreation of degenerates, in an honest, sensible, pure-minded manner. The medical fraternity knows the horrible price modern society is paying for this prudery. Their hospital records and the records of their private practice, were they made public, would be the blow that would stagger humanity.

The need for some radical immediate action is surely obvious. But what can be done? And how? The problem is more difficult than that of preventing the reproduction of ordinary defectives. Here sterilization (vasectomy) can be resorted to. But such measure will not help in the case of syphilis and gonorrhoea, for the infection would still remain. Registration, in order that the public may be in a better position to protect itself against this type of infection; detention under custodial care, until pronounced permanently cured by expert authority, in order that the source of infection may be properly controlled; and legal prohibition to marriage, in order that innocent and noble women may not be betrayed into a life of misery and sterility and that children may not be born with blighted heritage. One or the other of these safeguards alone will not be effective in meeting the demands of the situation; all together, coupled with an educational propaganda, must be observed coincidentally.

What are the difficulties regarding registration? First, expense. But in a country as potentially rich as America, and one that spends more than $100,000,000 annnually in caring for its defectives and unfortunates, this additional expense is a mere bagatelle. The creation and maintenance of the necessary machinery for registration

are relatively simple matters. How will regulation effect the solicitation of professional help on the part of those infected? Will not some continue untreated, become more virulent foci of infection and of protracted standing, suffer needless incapacity, and die a needless death in consequence? Possibly. But this condition is an inevitable transition phase from the old to the new order of things. Moreover, it being common knowledge that infected individuals will be registered in the department of health, any candidates for debauch may be restrained from taking the risks. Once the public is properly informed concerning the true and serious nature of these diseases, public sentiment will not simply tolerate, but indeed demand, registration.

What are the difficulties in the way of custodial care? Again, great expense. But wars have been fought and are being paid for; enormous quantities of tobacco, liquor and narcotics are still being consumed—without good, indeed with positive harm to the race—and the whole expense is patiently and cheerfully borne. Perhaps if it were made clear to our generation that, in consequence of our supine indifference and our shortsighted satisfaction with simply palliative measures, our children and grandchildren will inherit heavy burdens in the shape of enormous demands for the support of ever-increasing misery and incompetence, and that the welfare of the race is being jeopardized, we might become willing to sacrifice the enjoyment of superfluous comforts for this altruistic and of racial salvage. Surely no other course seems to hold such promise of permanent solution.

What are the difficulties in the way of procuring and enforcing restrictive legislation against the marriage of gonorrhoeal and syphilitic patients? In this case, only relatively small expense. But we we will have to combat here legislative lack of information, public prejudice, moral inertia, legal conservatism, clerical and institutional opposition, medical professional ethics, and the universal traditional fetish of "personal liberty" and "equal rights." Perhaps all that is needed, however, to overcome the opposition is a common sense educational propaganda. Progress may be slow, but a successful issue is inevitable.

Dr. Charles Elliots' remarks (*The Crusade for Sex Hygiene*) seem pertinent:

> It is absolutely inconsistent with all other public health measures that venereal patients, patients with syphilis or gonorrhoea, should be allowed to keep these diseases secret, should be walking about the streets, working in the shops

and factories, sitting in the street cars, and frequenting the hotels. We do not allow such conduct nowadays with regard to any other contagious diseases. . . . . It is high time, gentlemen, that this practice within the medical profession should be brought to an end, and that all venereal diseases should be registered and made subject to control as scarlet fever, diphtheria, and small-pox are. Indeed, the reasons for publicity with regard to venereal diseases are stronger than they are with regard to any other of the contagious diseases. In the second place, cities and states should make large public provision in dispensaries and hospitals for the treatment of the venereal diseases. They should be treated with a view to prevent their further distribution through the community.

In the third place, the practice of the medical profession needs to be completely changed in regard to their sense of responsibility towards innocent people who may be infected by persons whom the physicians know to have venereal disease. That is a very important point, and it is going to be a very difficult point in the prosecution of this crusade. It is the practice of many physicians to conceal the fact that the young man who is under treatment for venereal disease is so affected, even when the physician knows that the young man is about to marry an innocent girl. Many physicians justify that concealment, and say it is the only mode of action consistent with the general ethics of the profession, namely, a sacred confidence between the physician and his patient. That sort of ethics ought no longer to be endured.

But the most important phase of the evil, the primary cause of its considerable prevalency even among the better classes, remains to be considered, namely, prostitution. The publication of the Report (1911) of the Vice Commission appointed by the Mayor of Chicago—a commission composed of some of the best men and women of that city—gives cause for hope that measures for the extermination of prostitution will soon receive more general intelligent consideration. Above all, the report makes very clear that prostitution is not a negligible evil, but one of prime and fundamental import. When we are told that in Chicago alone $16,000,000 are the profits annually accruing from this vice, served professionally by 5000 (the most conservative estimate) potentially useful young women, and patronized by thousands of the best young manhood of our country, the evil appears as the most momentous that society has to contend against. For the ruin of this fair manhood, the consequent frequent suffering and sterility of their later marriage-mates, and the blasting of little children's lives presents a picture truly appalling. Multiply Chicago proportionately by the number of cities in this country and the world, and then contemplate the enormity of the results in terms of misery, degradation, poverty, blasted homes, ruined lives, and racial injury! Truly, this is not an evil that we can longer afford to harbor and neglect. Miss Jane Addams, of Hull House, Chicago.

in her recent series of four splendid articles in *McClure's Magazine* (1911–12) on "A New Conscience and an Ancient Evil," sympathetically portrays the evil in faithful colors and proper perspective. She would pay the price of another Civil War to rid the country permanently of this curse, and deem it infinite gain. It is most gratifying that social workers of her type and caliber sternly refuse to compromise with medical inspection, segregation, or "regulation"—in short, with anything less than absolute eradication. To say that to abolish an evil as old as the race is impractical or impossible is to belie one's native aspirations for a better world, and one's perennial faith in the final triumph of right. If prostitution ought to be abolished if it be possible, *then it can be abolished, for what is right is possible.* Indeed, for the life of the nation and the race it *must be abolished.*

One wishes to solicit here especially the help of the medical profession who too frequently simply connive at prostitution and its sequelae of disease; and of the clergy who largely ignore the latter in their relation to marriage. It is wrong also that physicians to venereal patients should count fidelity to the Hippocratic oath as of more consequence than the saving of an innocent girl from a necessarily unhappy marriage, and her possible offspring from probable defect. If the Hippocratic oath works such ill it ought no longer to be administered. Nor will properly trained high-minded physicians any longer respect it in those instances where it means harm to an unsuspecting individual or the unborn race.

Men have long held the legislative reins. Concerning those matters which relate most closely to woman's welfare and that of the race they have sometimes been indifferent and at other times they have largely bungled. They need expert advice from those most concerned, the women, to whom the future race is most closely related. Only woman can fully know the price paid for human life. She will no longer tolerate to have so valuable a thing so recklessly produced and so ruthlessly squandered.

Women will soon be universally admitted to equal suffrage with men, because it is *right* that they should be if they desire. The suffragist movement contains great possibilities for powerfully abetting the eugenic propaganda. Woman will legislate to properly protect herself as the "mother" of the race against wanton infection. She instinctively feels more keenly the importance of conserving the greatest national asset, human life, and will bring about proper action for the preservation of the best elements of the race. Of

course we shall probably have to pass through a period marked by radicalism and extremes. This is perhaps inevitable. But eventually men and women will together work out some ethical code of life in accordance with the best eugenic ideals.

THE FERTILITY OF HYBRIDS IN A MAMMALIAN SPECIES-CROSS

JOHN DETLEFSEN

Laboratory of Genetics, Bussey Institution, Harvard University

Sterility is a common phenomenon in the hybrids obtained by mating members of distantly related groups or types, both in animals and in plants. In fact, there is a tacit understanding among the taxonomists that members of the same species produce fertile offspring when mated inter se; but a successful cross between members of different species or genera may result in sterility of one or both sexes among the hybrids. In case both sexes are sterile, a further genetic study becomes impossible. When one sex alone among the hybrids is sterile, that sex is usually the male; and since the females are fertile, it becomes possible to study the inheritance of characters and fertility of offspring by crossing these female hybrids back to the males of either parent species.

Among mammals, at least, work on inheritance and fertility in species crosses is in its inception. Various compilers, such as Rörig and Przibram, have given lists of mammalian species crosses, with brief mention of the partial or complete dominance of one parent, and the fertility of the hybrids, when known. Grateful as we are for the facts that are thus accumulated, we must, nevertheless, admit their general inadequacy; for most mammalian species crosses were made by those who were merely interested in sheer possibility of the cross. Those breeders who are interested in the economic mammals have been the most fortunate, because most attention has been directed to their study. The consensus of opinion is that the time-honored cross between horse and ass results in sterile male mules but that the female mule is occasionally fertile with either the horse or ass (Waldow von Wahl, 1907). The zebroid (zebra $\times$ horse) is supposedly sterile in both sexes (Ewart, 1899; Iwanoff, 1911). The same is true of the zebrule (zebra $\times$ ass). When the cow and bison are crossed, they produce fertile female catteloes, but sterile males (Boyd, 1908; Iwanoff, 1911).

The offspring of the fertile female mule have merely been mentioned, but further reports regarding their fertility and other characters are lacking. The female hybrids between the cow and bison have been crossed back to males of both parent stocks, thus producing one-quarter bison, or three-quarters bison. The one-quarter bison females are fertile, as may be expected. The three-quarters bison female have not been fully tested, but are possibly also fertile. The one-quarter bison males are not always fertile, for Boyd reports the appearance of but one out of four tested males. Iwanoff reports a fertile three-quarters bison male; and supposes, on purely theoretical grounds, that a mating of such a fertile male with a quarter-bison female would result in fertile one-half bison of both sexes.

Material.—It has been the good fortune of the writer to work with the progeny of a mammalian species cross which in many respects is comparable to the horse-ass cross and bison-cow cross. It is my purpose to report briefly on the fertility of these offspring. The parent species were the wild Brazilian cavy (Cavia rufescens) and the domesticated guinea-pig (Cavia porcellus). The two forms differ consistently and clearly in color, texture of hair, size, shape of skulls and skull sutures, tooth formation, and the like. There is no doubt but that the two parent stocks are separate species; for, even if the evidence of the systematist were really arbitrary, such evidence must obtain more weight when one considers that the male hybrids are completely sterile.

The original crosses between these two species were the result of mating the wild males to the tame females. The reciprocal cross was not attempted, for, it was feared that the smaller wild female would succumb in pregnancy when mated to the much larger sized tame male. The wild males were wholly fertile, with tame females, although matings were secured only with much difficulty. The tame females bore their hybrid young in due time and with the usual guinea-pig average per litter. Now since the average number per litter in the tame guinea-pig is much larger than in the wild, and since a tame female gives this larger average, even when impregnated by a wild male, we have every reason to believe that such wild males are wholly fertile with tame females and the abundant number of spermatozoa insures complete fertilization. Having obtained these one-half wild hybrids, the females were mated back to the wild males and the tame guinea-pig males, producing three-quarters wild, and one-quarter wild respectively. The matings to the wild males were not very successful and only one three-quarters wild male was reared

to maturity. He was sterile. The matings to the tame males were wholly successful, and produced 83 one-quarter wild. Pursuing the same method of mating the hybrid females of one generation back to the tame guinea-pig males, there were produced a regular series of more dilute wild-blooded generations ranging from $\frac{1}{4}$ wild to the $\frac{1}{512}$ wild. In all, over 1700 hybrids of various blood dilutions have thus been produced. The fertility of about 400 male hybrids has been tested. All female hybrids are fertile.

Problems.—The wild males were wholly fertile in captivity, hence captivity itself may be eliminated as a factor causing the sterility of their less wild hybrid sons. The problem immediately suggested itself: how great must be the blood dilution, or for how many generations must the hybrid females be crossed back to the guinea-pig in order to eventually produce fertile male hybrids? When fertile male hybrids were produced, would all their offspring be fertile in both sexes, if such males were mated to their hybrid sisters or guinea-pig females?

Method.—To judge an animal's fertility, the breeding test is hardly sufficient. It is well known that a male may be potentially fertile, and yet fail to show it because of some physiological state, such as the emaciation of sickness or the sluggishness of obesity. Furthermore the number of males to be tested increased so rapidly that facilities were lacking to breed all of them. Hence, another test was devised. By making a small incision in the scrotum and puncturing the epididymis at one or several points, and placing the liquid contents in a normal salt solution at bodily temperature, with the aid of a microscope a complete index of the male's fertility was obtained.

Results.—Now, whereas any male always gave the same microscopic test during his adult life, there was a great difference between individual hybrids. Some males might not possess any sperm at all; but in their place were found a few or many incompletely matured spermatogonia. Other males might possess a few non-motile or motile spermatozoa in addition. Still others might have an abundance of motile spermatozoa, just as any normal male. All grades and combinations were found; but the last class alone could be successfully mated to females. Fully 200 offspring from such males have been born.

The results of the experiments on the male hybrids up through the sixth generation are given in the table presented. The one-half wild hybrid males had no spermatozoa. The succeeding generations

of less intense wild males present a consistent series, in which a continually increasing percentage of males show spermatozoa. Of the 21 males tested in the sixth generation, or the $\frac{1}{64}$ wild, all had spermatozoa. But the mere presence of sperm does not produce fertile males. In order that fertilization of the egg shall take place, the sperm must be motile to reach and penetrate the egg. Many males with immotile sperm were mated to females, but invariably gave the same result: no progeny.

When we consider those males which had any motile spermatozoa whatsoever, we find the same sort of a series. The $\frac{1}{2}$ wild hybrid males had no sperm and naturally would have none which were motile. The $\frac{1}{4}$ wild males likewise had no *motile* sperm, although we saw in the previous column that 25 per cent showed sperm. The $\frac{1}{8}$ wild males were the first which showed motile sperm, and were likewise the first to be successfully mated with females. The per-

Table of fertility of hybrid males.

Class of hybrids.	Total number tested.	per cent with any sperm.	per cent with any motile sperm.	per cent readily fertile.
$\frac{1}{2}$ wild	6	0	0	0
$\frac{1}{4}$ wild	22	25.0	0	0
$\frac{1}{8}$ wild	71	47.8	17.3	9.8
$\frac{1}{16}$ wild	94	71.1	46.6	35.5
$\frac{1}{32}$ wild	89	88.7	62.9	60.7
$\frac{1}{64}$ wild	21	100.0	66.7	66.7

centage of males with motile sperm increased rapidly in each succeeding generation until finally the $\frac{1}{64}$ wild showed 66.7 per cent with motile sperm. So far as I have been able to test, it would seem that any male with motile spermatozoa is fertile; but in those cases in which immatured spermatogonia or non-motile spermatozoa greatly outnumber the motile spermatozoa, the chances that such will reach and penetrate an egg are small. An intimate study of the motility of sperm and the possibilities of obtaining offspring from male hybrids, has led me to believe that any male with an abundance of motile sperm is readily fertile. Abundance of motile sperm means at least one-half motile. The last column gives the percentages of male hybrids in each generation, which are readily fertile and which can successfully impregnate females. This last category shows the same sort of increase that the others show. It is therefore clear that fertile male hybrids may be produced in constantly increasing numbers in the offspring of a cross which originally gave only sterile males and fertile

females. In the original cross, elements are introduced or formed which prevent the full maturation of the male reproductive cells, but the female reproductive cells seem unaffected. These disturbing elements may be eliminated by continually crossing the female hybrids back to normal tame males, thus producing fertile male hybrids.

Offspring of fertile male hybrids.—It is not out of place to mention the fertility of the sons of the fertile male hybrids. The male hybrids with an abundance of motile spermatozoa could be successfully mated to female hybrids, and to tame female guinea-pigs.

When a fertile male hybrid was mated to a female hybrid their male offspring were not necessarily fertile. We hardly expected they would be, for the female might transmit the disturbing elements in this cross just as much as when mated to a tame guinea-pig. About forty male hybrids from this sort of a cross have been tested, and they give all grades between absolute sterility and fertility.

When, on the other hand, a fertile male hybrid was mated to the guinea-pig female, all the male offspring have been fertile. This is the expected outcome, for the fertile male hybrid may be regarded as a sort of recessive, in which the disturbing elements introduced in the original cross have been eliminated; and when he is mated to the female guinea-pig, no such elements are again introduced. About thirty male hybrids from this class of crosses have been tested and all found to be wholly fertile.

Practical application.—If the cattaloes, mules, and other mammalian hybrids are at all comparable to the hybrids in these experiments, then fertile races of such hybrids may be produced in the same manner. As a simple illustration, I may say that all the color, coat, size, and anatomical characters known in guinea-pigs, have been transferred to these hybrids. Any combination of these characters may be united with fertility. It is conceivable that desired characters in hybrids between other mammalian species may be combined with fertility of both sexes, in the same manner.

FIRST ANNUAL CONFERENCE OF THE EUGENICS FIELD WORKERS

SUPT. H. H. LAUGHLIN

Cold Spring Harbor, New York

The recent interest in the study of human heredity has led to the development of a new sort of specialist—the eugenics field worker—

whose business it is to go into the home neighborhoods of certain persons for the purpose of studying and charting their family connections and describing each individual of the network with care and accuracy with special reference to traits characteristic of the family. Modern eugenic research which seeks among other things, to determine the manner of the inheritance of traits demands that authentic and extended pedigrees be provided for study. Experience has taught that such data can be secured only by sending trained field workers into the home territories as above mentioned. Up to the time of this conference, which was called by Dr. Davenport at the Eugenics Record Office, Cold Spring Harbor, Long Island, New York, on June 20 and 21, 1912, thirty-two persons had, at some time during the preceding three years, been engaged in this new sort of work. Twenty of these workers were present at the conference.

Prior to this meeting several meetings of the research committees of the Eugenics Section of the American Breeders Association had been held, but there the research committees held sway and the field worker played a secondary rôle. The June meeting, however, was primarily a field workers' meeting. They met for the purpose of exchanging experiences, for receiving fresh inspiration and new ideals, for standardizing the methods of charting authentic pedigrees, and for standardizing the use of descriptive terms. The methods for recording descriptions of individuals and for charting family pedigrees suited to eugenic study were standardized in 1910 by the Eugenics Record Office, the Skillman School for Epileptics, Skillman, N. J., and the Training School at Vineland, N. J., and published in Bulletin No. 2 of the Eugenics Record Office. This Bulletin will shortly be supplemented by Bulletin No. 7—the Family History Book by Dr. C. B. Davenport. This latter bullentin is in reality a field workers' manual.

In view of the rapidly growing demand for trained field workers in eugenics it is doubtless of interest to recall that this method of securing at first hand the data for the careful study of the inheritance of human traits was foreshadowed by Robert L. Dugdale in his work on the "Jukes" in the isolated valleys of New York; by Dr. Oscar McCullough of Indianapolis who, a generation ago, instituted field study of the degenerate "Ishmaelites" of Indiana; and by Dr. Alexander Graham Bell, who made a careful family trait survey of Martha's Vineyard, R. I. Such field work in human heredity has for its purpose the working out of pedigrees of sufficient accuracy and detail to justify prediction as to the hereditary potentialities of selected strains and individuals.

The work in the study of human heredity in America followed closely upon the genetics revival of recent years. Prof. C. W. Farabee, of Harvard University, who made observations on the inheritance of brachydactylism, and Dr. and Mrs. Davenport of the Carnegie Station for Experimental Evolution, who made studies in the inheritance of the characteristics of human eye color, and skin color and hair color and form, were the earliest American investigators by the new methods, of human traits. The growth of eugenics research has been so rapid within the last three years that now institutions in Massachusetts, New Hampshire, New York, New Jersey, Michigan, and Minnesota are employing trained field workers. Since this conference was held (the date of this writing is August 15, 1912) this office has made agreements with one institution in Minnesota, one in Illinois, one in New York, one in Pennsylvania, and two more in Massachusetts whereby trained field workers are to begin eugenic studies on October 1, 1912. Two more workers are also to be added to the office staff of the Eugenics Record Office.

This growth is permanent because it is built upon truth. A body of facts, sufficient to enable eugenists to determine the laws governing the behavior in heredity of specific traits, is being built up by the professional work of these trained field workers. Slowly but surely eugenics is wresting from nature the truth concerning the manner of the inheritance of human traits, and it is becoming apparent to state administrative and institution officials, to social workers, and to men of science generally that the problems of the social misfits among humanity are at root biological problems that ultimately must be solved by applying biological remedies, in essence if not in external or social aspect identical, with those applied by the breeders of plants and animals in the rise of domestication. New York State, through its State Board of Charities, has recently established a Bureau of Analysis and Investigation. This is essentially a bureau of eugenics, and will devote its attention to the eugenic aspects of the work of the State Board of Charities. Dr. Gertrude E. Hall is chief of this new bureau, and has recently held its first civil service examination for the selection of field workers. Ultimately every state must look toward the cutting off of its supply of defectives rather than of maintaining more institutions as the final solution of the problem of social misfits, and from the history of the field workers movement in the last three years, it is evident that the states are appreciating the ultimate possibilities of applied eugenics.

FIRST ANNUAL FIELD WORKERS' CONFERENCE, EUGENICS RECORD OFFICE, COLD SPRING HARBOR, LONG ISLAND, NEW YORK, JUNE 20 AND 21, 1912

Standing (left to right).—Mary M. Sturges, employed by the Eugenics Record Office in studying consanguineous marriages on the islands off the Maine Coast. Former Eugenics work, study of family distribution of cancer for the Crocker Cancer Research Fund.

E. P. Moore, employed jointly by the Eugenics Record Office and the New Jersey State Hospital, Trenton, N. J., in studying the inheritance of insanity in the New Jersey State Hospital. Former eugenics assignment, study of family distribution of cancer for the Crocker Cancer Research Fund.

Helen T. Reeves, employed by New Jersey State Home for Feeble-Minded Women, Vineland, N. J., in studying the inheritance of feeble-mindedness in families represented in that institution. Formerly employed jointly by that institution and the Eugenics Record Office.

Elizabeth S. Kite, employed by the Vineland (N. J.) Training School for Feeble Minded Boys and Girls in studying the inheritance of feeble-mindedness in families represented in that institution.

Marion Collins, employed by the Monson State Hospital, Palmer, Mass., in studying the inheritance of epilepsy in the families represented in that institution.

Dr. Elizabeth B. Muncey, employed by the Eugenics Record Office in studying the inheritance of Huntington's chorea in New York, Connecticut, New Jersey, and Pennsylvania families.

Jane H. Ross, employed jointly by the Eugenics Record Office and the Government Hospital for the Insane, Washington, D. C., in studying the inheritance of insanity in families represented in that institution.

Mrs. George A. Hathaway, employed jointly by the Eugenics Record Office and the State Industrial School for Girls, Lancaster Mass., in studying the inheritance of delinquency in families represented in the latter institution.

Ruth S. Moxcey, employed jointly by the Eugenics Record Office and the Danvers State Hospital, Hathorne, Mass., in studying the inheritance of insanity in families represented in the latter institution.

Ruth W. Lawton, employed jointly by the Eugenics Record Office and the Boston State Hospital Dorchester, Mass., in studying the inheritance of insanity in families represented in the latter institution.

Veda Elvin, employed by the New York State Reformatory for Women, Bedford Hills, N. Y., in studying the inheritance of traits of delinquency in families represented in that institution.

Ethel C. Macomber, employed jointly by the Eugenics Record Office and the New Hampshire State Hospital, Concord, N. H., in studying the inheritance of families represented in the latter institution.

Florence H. Danielson, employed by the Eugenics Record Office in making a eugenics survey of Woodbury Town, Connecticut. Former assignments, jointly employed by the Eugenics Record Office and the Monson State Hospital, Palmer, Mass., in studying the inheritance of epilepsy in families represented in the latter institution. Employed by the Eugenics Record Office in studying the inheritance of skin color in mulatto families in Bermuda and Jamaica, B. W. I.

Sitting (left to right).—Dr. Arthur H. Estabrook, employed by the Eugenics Record Office in extending the studies of Robert L. Dugdale on the "Jukes." Former assignments, study of the inheritance of albinism in Eastern Massachusetts, and the study of inheritance in the criminal insane at the Matteawan State Hospital Fishkill-on-Hudson, New York, and the study of the heredity of the "Nam" family of degenerates in "Nam Hollow."

Amey B. Eaton, employed jointly by the Eugenics Record Office and the Utah Agricultural College, Logan, Utah, in studying the inheritance of mental and physical traits in the Mormon families in Salt Lake Valley, Utah. Formerly employed by the Eugenics Record Office in seeking data upon the inheritance of biological traits recorded in American genealogies, and in studying the inheritance of mental and physical traits in the Amish sect in Pennsylvania.

Mrs. D. L. F. Woodward, employed by the Skillman (N. J.) State Village for Epileptics, in studying the inheritance of epilepsy in families represented in that institution.

Florence Orr, employed jointly by the Eugenics Record Office and the New Jersey State Hospital, Trenton, N. J., in studying the inheritance of insanity in the families represented in the latter institution. Former eugenics work; in Kings Park State Hospital, Kings Park, N. Y., studying the inheritance of insanity in families represented in that institution.

H. H. Laughlin, Superintendent of the Eugenics Record Office.

C. B. Davenport, trustee and director of the Eugenics Record Office; Director of the Station for Experimental Evolution, Carnegie Institute of Washington, Cold Spring Harbor, Long Island, New York.

William F. Blades, editorial secretary, Eugenics Record Office. Also especially studying the inheritance of hare-lip and cleft palate.

Besides those who attended the meeting, the following have also been engaged in field work in eugenics: Miss Jane Griffith, who was for some time employed in field work by the Vineland (N. J.) Training School; Miss Saidee C. Devitt, now a field worker of the Faribault, Minnesota, School for Feeble-Minded, was formerly employed by the Skillman School for Epileptics in the same work; Mary O. Dranga was formerly employed by the Eugenics Record Office in studying the inheritance of factors in juvenile delinquency in the Chicago Psychopathic Institute and later engaged in extending the work of Dr. Oscar McCullough on the "Ishmaelites" of Indiana; Adele McKinnie is employed jointly by the Eugenics Record Office and the Michigan School for Feeble-Minded, Lapeer, Mich.; Maud W. Moore, formerly employed by the Vineland Training School in eugenics field work; Gertrude C. Cannon, formerly employed by the Kings Park State Hospital, Kings Park, N. Y.; Miss Florence R. Davis, archivist, Eugenics Record Office; Susan K. Gillian, employed by the Eugenics Record Office in studying the inheritance of skin color in mulatto families in Louisiana; Dr. Jaime de Angulo, employed by the Eugenics Record Office in describing the effects of vasectomy upon the inmates of the Indiana Reformatory, Jeffersonville, Indiana, and later in charting out pedigrees of these men with reference to criminalistic traits; and H. H. Le Seur, who has succeeded Dr. de Angulo in the same work.

SOME BIOLOGICAL PRINCIPLES OF ANIMAL BREEDING

W. E. Castle

Bussey Institution, Forest Hills, Massachusetts

Animal breeding is the most ancient of all arts. Its beginnings antedate civilization, going back to a time when man lived as the beasts of prey live, subsisting upon such animals as he could catch or kill. As man increased the game began to decrease, and the more provident would keep alive for a time the young of their favorite animal, when taken, until these young had grown larger and would yield more food. Often no doubt, a feeling of attachment grew up between captor and captive and the day of slaughter was postponed until the captive had reached breeding age. If young were born in captivity, the thought must at once have occurred to the observer, "Here is an easier and more sure way of getting food than by hunting; why not raise cattle and sheep rather than hunt them." But not all men reasoned thus or, if they did, abandoned the chase, for this continued with increased vigor. The game grew scarcer and wilder and was pursued into less accessible places. Horses and wild dogs were employed to aid in the chase. Wild cattle were hunted to death and wholly exterminated, and wild sheep were almost exterminated. The disappearance of the wild form gave impetus to the propagation of the tame one. Thus the pastoral stage of man's existence was reached. He moved from place to place in search of forage for his flocks and herds, the dog and the horse being his assistants. The most important of our domesticated animals trace back their existence to this stage of culture. The flocks and herds furnished flesh, milk, clothing and shelter; the horse transportation; the dog defense, aid in the care of the flock, and, not least, companionship. Under the open sky, watching the stars by night and the changing seasons by day, man laid the foundation of the first science, astronomy. In the fertile river valleys, he found he could raise food for himself and his animals when the supply on the plains grew short. Thus agriculture began. It necessitated fixed abode in one spot, regulations as to land-tenure, irrigation, and the like. New uses were now found for the animals; the ox was yoked to the plow, and the horse was harnessed. Thus civilization began, largely through the instrumentality of domesticated animals.

Though animal breeding is the oldest and most fundamental of the arts, its practise down to the present time has been almost wholly

empirical. A science of animal breeding scarely yet exists, not because thoughtful men have failed to give attention to the subject but rather because of its inherent difficulty. We breed animals as our fathers and grandfathers did because their time-honored methods succeed and we know of no reason for changing those methods. Indeed we can not expect to improve them in a rational way until we learn why certain methods succeed and why others fail. Such knowledge of the underlying reasons for successful practise will when secured constitute a science of animal breeding.

The technique of successful animal breeding is difficult and special in the case of each kind of domesticated animal and can best be learned from an apprenticeship on a farm or study in a farm school. The general principles empirically deduced from centuries of practise may be concisely stated thus:

(1) *Like begets like,* hence the breeder must select for propagation the type of animal he desires to perpetuate.

(2) *Pedigree counts.* The desired type is more certain to occur among the offspring, if it has occurred repeatedly among the ancestors.

(3) *Inbreeding* brings uniformity of type but causes loss of vigor.

(4) *Crossbreeding* increases vigor but destroys uniformity of type.

No one of these generalizations is universally true. To state the recognized limitations and exceptions would be to recapitulate the literature of breeding with the omission only of its technique. The new science of genetics is concerned with the discovery of the reasons for these four empirical generalizations and their various exceptions.

To the very first of the four generalizations there are frequent exceptions as every experienced breeder knows. Like does not always beget like. Thus roan short-horned cattle do not always breed true. They produce their like, roans, in about 1 case out of 2, but in the remaining case an all-red or an all white or a spotted red-and-white animal is likely to be produced. Blue Andalusian fowls are another well known exception to the rule that like produces like. Besides producing blue offspring, Andalusian fowls produce also black ones and white ones. Yellow mice are another unfixable variety of animal. They breed true in about 2 cases out of 3. In the third case a black or brown pigmented animal is produced. Illustrations need not be multiplied; the literature of breeding is full of cases in which like has failed to produce like. Until quite recent years no satisfactory explanation of such cases has been forthcoming. Why a roan variety of cattle or a blue variety of fowl should be fixable to the extent of 50 per cent, whereas yellow mice should be fixable to

the extent of 66 per cent was quite incomprehensible until a general law of color inheritance had been worked out.

The first serious attempt to formulate a general law of heredity was made in 1889 by Francis Galton, a pioneer in the study of genetics. He went about the matter in a systematic way, first collecting facts and then generalizing from them. In studying family records of the height of human beings he observed both that like begets like and that pedigree counts. For tall children are in general born only to tall parents, and the children are more certain to be tall if the grandparents also have been tall. He concluded that the resemblance of children to their grandparents was on the average only half as close as to their parents. Or to express it mathematically, if we call the parental influence one-half, that of the grandparents is one-fourth; that of the great-grandparents one-eighth; and so on, each earlier generation of ancestors exerting only half as much influence as the next later one. This generalization, at first adopted tentatively only, Galton called the law of ancestral heredity. It states the facts of relative average size of ancestors and offspring about as well as we can state them at the present time, but offers no biological explanation of this relation. Nor does it inform us as to the probable limits of size variation among the children. This so-called law of Galton in reality rests on a false biological assumption, viz., that the character of the germ-cell regularly corresponds with that of the parent producing it. Galton himself recognized and pointed out this defect, but could devise no way of obviating it.

In order to test his empirical law more widely Galton in 1897 applied it to a case where it is now clearly not applicable, viz., to color inheritance in mammals. The particular case selected by him for study was unfortunately a peculiarly difficult one, viz., the inheritance of black spots in Bassett hounds. The result was that he reached erroneous conclusions.

The race of dogs studied was the Bassett hounds of Sir Everett Millais, a carefully bred race having the short crooked legs of a Dachshund combined with the spotted coat of a beagle. Careful records had been kept of the breeding of these dogs for many generations. In most respects they had been bred to a uniform type, but in color two different conditions occurred. The dogs were all (or nearly all) spotted yellow-and-white. Part of them bore in addition spots of black, being thus *tricolor* yellow-black-and-white. Those without black spots were called by Galton non-tricolor.

Galton found on examination of the records that parents of one

sort may produce young of the other sort as well as its own, though in smaller numbers. Neither kind, then, breeds entirely true, though each tends to produce its like. It was found further that parents produce a larger proportion of offspring like themselves if the grandparents also have been of that same sort. Hence there exists an apparent ancestral influence which Galton believed to be roughly approximated by his mathematical law. That this influence is apparent only, not real, I have shown elsewhere.[a]

Galton had verified in this case as in that of human stature, the two, century-old generalizations, "Like begets like" and "Pedigree counts." He had attempted to measure the force of pedigree in his law of ancestral heredity, but not to account for it.

A more successful attempt to formulate a general law of heredity had been made some years earlier by Gregor Mendel, but this was

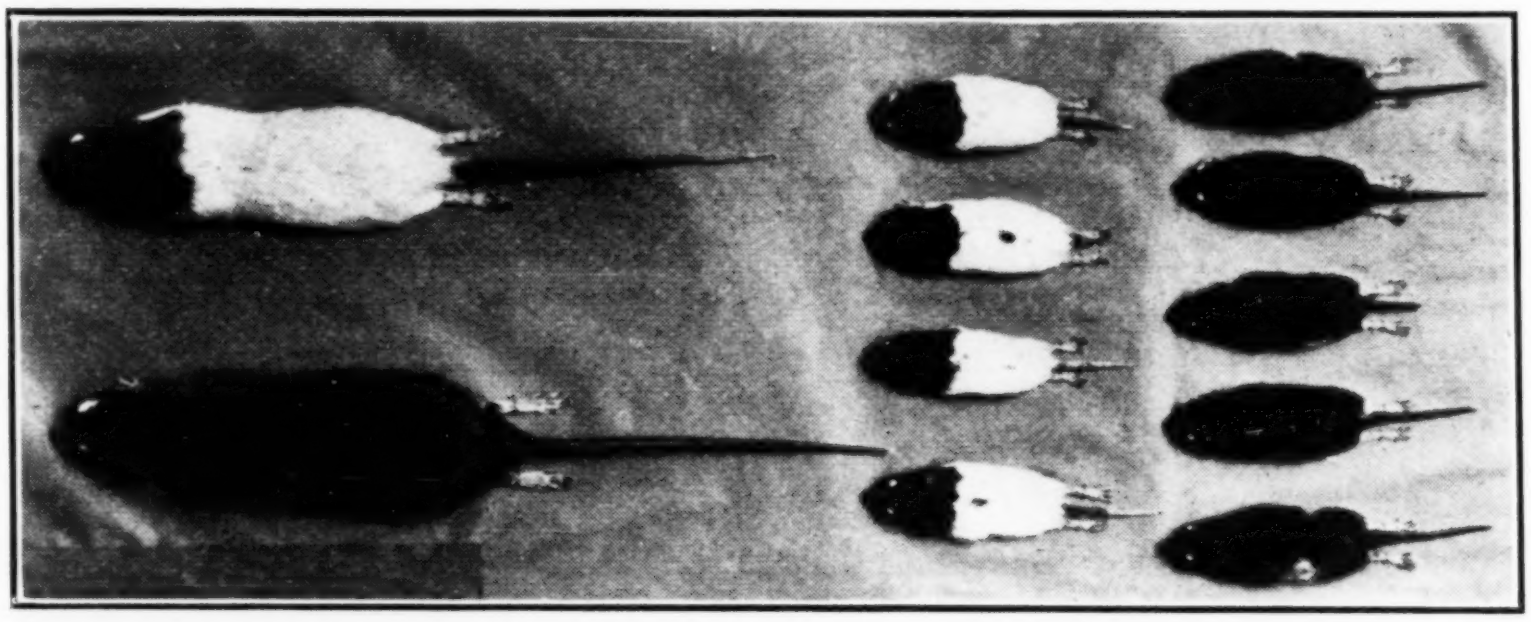


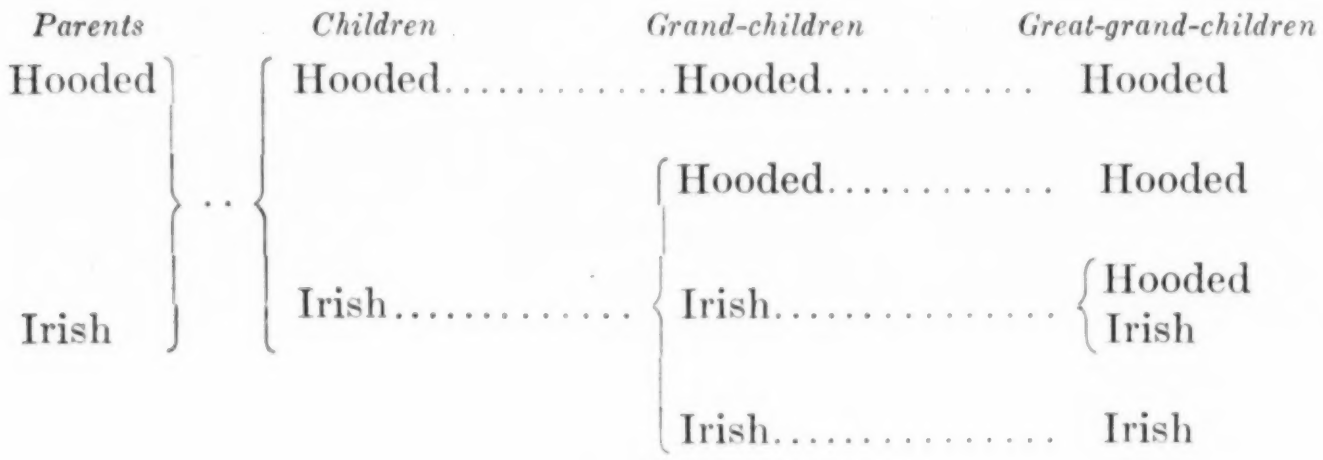
FIG. 1—A FAMILY OF RATS, THE PARENTS AT THE LEFT, THEIR OFFSPRING, A SINGLE LITTER AT THE RIGHT

unknown to Galton as to other biologists of that time. We call it Mendel's law. In accordance with this law, the facts of color inheritance observed by Galton can be more fully explained.

It is a fundamental feature of this law that the characteristics of animals and plants are inherited as units. For example, in figure 1 are seen the skins of a family of rats; of the parents at the left, of their offspring at the right. The parents obviously differ in coloration, and the young are divided in a corresponding way into two groups approximately equal. Five of the young resemble one parent,

[a] The Laws of Heredity of Galton and Mendel, and Some Laws Governing Race Improvement by Selection. Proc. Am. Acad. Arts and Sci., vol. 39, pp. 223–242, 1903; On The Inheritance of Tricolor Coat in Guinea-Pigs, and its Relation to Galton's Law of Ancestral Heredity. *American Naturalist*, vol. 46, pp. 437–440, July 1912.

four resemble the other. The grouping of young into two classes has no relation to sex; each group includes both sexes. In both groups the animals are particolored, black and white, but in one group the black areas are more extensive than in the other. In one group the black head and back-stripe alone are black; these are called "hooded" rats. In the other group the entire dorsal surface is black; these are "Irish" rats. In neither group is the extent of the pigmentation absolutely uniform; it varies within narrow limits, yet the limits of the two groups are widely separated. No one would hesitate for a moment as to the grouping of any individual. If each group had been reared to maturity and had been allowed to breed separately, it would have been found that the hooded rats bred true, but that the Irish group produced again two sorts, Irish and hooded. If these grandchildren had in turn been sorted out into groups and bred separately, it would have been found that hooded rats would again produce only hooded young, whereas the Irish grandchildren would some of them again produce two sorts of young, Irish and hooded, while others would produce only Irish young. See the following diagram.



To make a long story short, this is a good example of alternative or Mendelian inheritance. Irish is the dominant pattern, hooded recessive. Recessives always breed true, but dominants are of two sorts, those which breed true (called homozygous), and those which do not breed true (called heterozygous) but also produce recessives.

The original Irish parent in this family was heterozygous. In half its gametes the hooded condition was transmitted, in half the Irish condition. The Irish children were of the same sort, as would be found also part of the Irish grandchildren, but others of the Irish grandchildren would be found to be homozygous, transmitting nothing but the Irish character, and these would breed true. The noteworthy thing in this experiment is the demonstration that hooded and Irish patterns behave as alternative units, which may be brought

together in the same individual by cross breeding and then separated out again in later generations.

If instead of crossing a hooded rat with an Irish one, as in the family already discussed, we cross it with a wild gray one, we obtain a different result. The children are all gray like the wild parent, but the grandchildren are of four sorts, gray-all-over, black-all-over, gray hooded, and black hooded, approximately in the proportions, 9 : 3 : 3 : 1. By a cross two new color varieties have been created, the all-black and the gray hooded. It is evident that in this case, as in the foregoing, color-pattern is sharply alternative in inheritance, but the wild parent was homozygous in pattern not heterozygous, so all the children showed that same dominant pattern, and the hooded pattern reappeared first among the grandchildren, in one-fourth of the individuals. But among the hooded grandchildren, as well as among the self colored, both gray individuals and black ones occur. The same pattern occurs portrayed in different tints, gray or black. It is evident therefore that the gray color is alternative to black in the same way that self pattern is alternative to hooded. It is evident further that color and pattern are wholly independent, just as I may write the letter *A* either in red or in blue crayon. There is no necessary relation between the letter which I write and the color in which I write it.

Likewise the hooded, Irish, and self patterns of rats may be portrayed either in black or in gray. Color and pattern in rats are therefore units independently transmitted in heredity and the varieties produced by crossing are nothing but new combinations of these same units. It is conceivable however that a new variety might be produced by actual alteration of one of these units, that the black for example might become blacker, or the gray might become lighter and that the modified units might still behave as alternatives. But the idea has somehow become prevalent among students of heredity that such modification is impossible, that Mendelian units cannot change. We have got in the habit of designating unit-characters by symbols, A, B, C, etc., and we have come to think of unit-characters as no more variable than these symbols. In reality no two organisms are ever exactly alike, and it is doubtful whether any unit-character is ever exactly the same in any two organisms. Some would frankly admit this and yet maintain that what is transmitted is in every case the same, that is that the germinal basis of a unit-character is unchangeable, whatever may be true of its manifestation in the individual. The theoretical consequence of such a view is

that selection can have no effect in modifying unit-characters. This conclusion is frankly avowed by many leading students of genetics. To show its unsoundness, it will be sufficient in a specific case to modify a unit-character. Many unit-characters have been so modified. I will describe a case in which the hooded pattern of rats has been changed by selection. This work has been done with the assistance of Dr. John C. Phillips, though others of my associates have shared in it to a lesser extent.

TABLE 1.—*Results of Selection for Modification of the Coat-pattern of Hooded Rats.*

Description of selection.	Number of generation.	Average grade parents.	Average grade offspring.	Number of offspring.
Plus series shown in figure 2.	1	2.51	2.05	150
	2	2.52	1.92	471
	3	2.73	2.51	341
	4	3.09	2.72	444
	5	3.33	2.90	610
	6	3.52	3.11	861
	7	3.56	3.20	1,077
	8	3.75	3.48	1,408
	9	3.78	3.54	1,322
	10	3.86	3.72	706
	11	3.94	3.76	158
Total				7,548
Minus series shown in figure 2.	1	1.46	1.00	55
	2	1.41	1.07	132
	3	1.56	1.18	195
	4	1.69	1.28	329
	5	1.73	1.41	701
	6	1.86	1.56	1,252
	7	2.00	1.70	1,680
	8	2.05	1.80	1,655
	9	2.11	1.92	1,591
	10	2.18	2.01	1,406
	11	2.27	2.16	543
Total				9,539

Several years ago the experiment was begun of selecting from a stock of hooded rats extreme plus and minus variates and breeding the two selections separately. The most extreme variations of the hooded pattern at the outset are indicated roughly by grades -2 and $+3$ of figure 2. At first the two series overlapped in the region of grade 0, but soon they ceased to do so and have drawn wider and wider apart ever since. In each generation the most extreme individuals were selected as parents. Table 1 shows the average grade of parents and offspring in each generation. But tables 2 and 3 show the average grade of offspring of parents of a particular grade

in each generation. Attention is called to the following facts concerning the plus selection, that is, selection in the direction of blackness and solid color (table 2).

(1) At the outset the darkest parents we had were of grade 3, now we have parents of grade $5\frac{1}{2}$, an all-black rat being grade 6 (the self condition). It is evident, therefore, that new grades of parents have appeared during the experiment; the table shows that they have come in gradually, $3\frac{1}{4}$ grade parents, in the third generation; $3\frac{1}{2}$ grade parents, in the fourth generation; $3\frac{3}{4}$ grade and 4 parents, in the fifth generation, and $4\frac{1}{4}$ grade parents in the seventh generation. The modification has progressed through all intermediate stages between hooded and self, including Irish.

(2) An examination of the horizontal rows of the table shows that in any generation the higher the grade of the parents, the higher

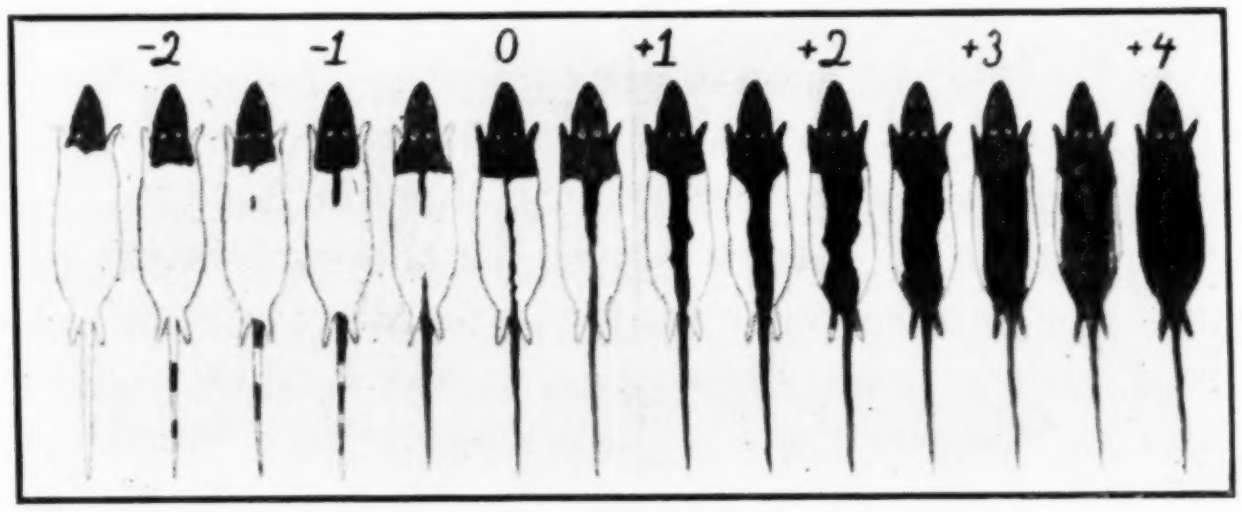


FIG. 2—AN ARBITRARY SET OF GRADES USED IN ESTIMATING THE EXTENT OF THE PIGMENTATION IN A RACE OF HOODED RATS.

that of their offspring. In general therefore the somatic character of an animal in this series is an index of its genetic character. This makes change through selection possible.

(3) An examination of the vertical columns of the table shows that upon the appearance of a new grade of parents, the regression of the offspring is considerable, but with further selection it diminishes. I may add, what this table does not show: that with repeated selection it disappears altogether and is even reversed. That is, the lowest-grade offspring produced by selected high-grade parents do not regress *downward* toward the starting point of the series, but *upward* toward the mode of the parental generation. This indicates that the effects of the selection are permanent, for a new mode has been created toward which regression occurs.

In the minus selection series (table 3) the initial selection consisted of animals between -1 and -2 in pigmentation. Pairs of -2 par-

TABLE 2.—*Relation Between Average Grade of Parents and*

Average grade of offspring.	Number of generation.	Average grade									
		1.87	2.00	2.12	2.25	2.37	2.50	2.62	2.75	2.87	3.00
	1	1.82 (7)	1.76 (18)	.....	1.87 (20)	.....	2.06 (37)	2.15 (5)	2.12 (51)	.....	2.35 (12)
	2	.....	1.70 (46)	1.28 (56)	1.87 (8)	1.92 (45)	1 80 (133)	2.11 (44)	1.92 (52)	2.41 (23)	2.47 (59)
	3	.....	.....	2.06 (21)	.....	2.15 (17)	2.32 (54)	2.63 (64)	2.46 (43)	2.70 (47)	2.49 (71)
	4	.....	.....	.....	.....	.....	2.55 (11)	.....	2.65 (18)	2.97 (37)	2.60 (143)
	5	.....	.....	.....	.....	.....	.....	.....	3.00 (12)	2.87 (21)	2.81 (15)
	6	.....	.....	.....	.....	.....	.....	.....	.....	.....	3.25 (2)
	7	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	8	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	9	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	10	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
	11	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
		Total.....									

NOTE.—Figures in parentheses show numbers of offspring on which the averages in each case are based.

ents occur for the first time in generation 4. Table 3 shows for this series the relation of average of offspring to grade of parents, and the results agree in every respect with those of table 2. Note, that:

(1) New grades of parents appear as the experiment progresses. We how have parents pigmented only on the top and sides of the head, and with a large white spot on the forehead. If such rats have ever existed elsewhere at any time, I have failed to learn of them.

(2) The higher the grade of the parents in any generation, the higher that of their offspring.

(3) Regression grows less with repeated selection and finally changes its direction.

What is the conclusion of the whole matter? We find that hooded, Irish, and self patterns in rats, though Mendelizing as unit characters in relation to each other, are quantitative variations no more stable in character than intermediate stages; that any desired intermediate stage may be produced by selection alone, and when produced is fully as stable as any one of the three conditions named; that in a similar way stages of less pigmentation than any previously known in rats other than albinos have been produced and that there is every reason to suppose that this reduction can be carried forward by selection until all color is eliminated from the coat.

Selection consequently is not a mere agency for the sorting out of unit variations (factors or genes); it is a creative agency by means of which unit characters can be modified and variation can be given

Average Grade of Offspring in Plus Selection Series.

of parents.											Number of Offspring.
3.12	3.25	3.37	3.50	3.62	3.75	3.87	4.00	4.12	4.25	4.37	
.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	150
2.50 (5)	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	471
3.07 (10)	3.17 (6)	2.91 (8)	.....	.....	.....	.....	.....	.....	.....	.....	341
2.69 (122)	2.89 (64)	2.70 (23)	3.02 (20)	.....	2.75 (6)	.....	.....	.....	.....	.....	444
2.81 (114)	2.81 (138)	2.94 (145)	2.87 (69)	3.08 (64)	3.07 (14)	3.35 (8)	3.36 (7)	3.00 (3)	.....	.....	610
2.84 (28)	3.10 (143)	2.96 (123)	3.10 (212)	3.16 (181)	3.22 (78)	3.26 (80)	3.41 (14)	.....	.....	.....	861
2.87 (28)	3.09 (131)	2.97 (160)	3.18 (177)	3.23 (289)	3.35 (184)	3.49 (90)	3.53 (15)	.....	3.75 (3)	.....	1,077
.....	.....	.....	3.46 (59)	3.50 (484)	3.49 (469)	3.53 (238)	3.31 (64)	3.72 (60)	3.69 (22)	3.96 (8)	1,408
.....	.....	.....	3.25 (4)	3.43 (244)	3.50 (591)	3.65 (424)	3.57 (45)	3.57 (7)	3.75 (4)	3.50 (3)	1,322
.....	.....	.....	.....	.....	3.68 (252)	3.72 (307)	3.76 (107)	3.77 (32)	3.84 (8)	.....	706
.....	.....	.....	.....	.....	3.75 (4)	3.67 (88)	3.88 (55)	3.75 (7)	.....	3.94 (4)	158
.....											7,548

a particular direction, the only limits to its action being physiological limits.

But someone may say, you have considered merely one sort of unit character; grant that this is modifiable, what of the numerous other ones which have been described? In reply I can only say that I confine my attention to one for lack of space. I have not limited my study to one, and I have yet to meet with a unit-character which is not both variable and modifiable. It is only by closing one's eyes to minor variations that one can see gametic purity in heredity. Some recognize the occurrence of these minor variations but deny that they are of any consequence. This is the position of de Vries and Bateson, Johannsen, and Jennings. Bateson for example in studying the inheritance of an extra toe in fowls recognized that it was not always equally well developed; nevertheless he grouped together in one class (having the extra-toe) all animals which developed even a trace of it, and placed in another class (as not possessing it) all which failed to develop an extra-toe, even though some of the latter actually did transmit the extra-toe. Now this is perhaps the best one can do in sorting out the material; but it is clearly unwarrantable to conclude that all fowls with an extra-toe possess a unit character or gene which is wanting in all birds which do not have the toe, or *vice versa*. Clearly toe-character is inherited in various grades precisely as whiteness is in rats. Undoubtedly toe-character also is modifiable by selection; indeed I have fully established this fact in guinea-pigs (1906).

TABLE 3.—*Relation Between Average Grade of Parents and*

Average grade of offspring.	Number of generation.	Average grade						
		1.12	1.25	1.37	1.50	1.62	1.75	1.87
	1	.....	1.34 (8)	0.85 (31)	1.37 (6)	.....	.....	1.05 (10)
	2	1.05 (12)*	1.17 (17)	1.45 (5)	1.11 (37)	0.67 (3)	1.09 (27)	1.10 (12)
	3	0.85 (5)	1.05 (20)	1.03 (28)	1.31 (28)	1.22 (48)	1.26 (63)	1.96 (3)
	4	.....	1.56 (4)	1.16 (29)	1.31 (59)	1.36 (40)	1.34 (93)	1.18 (95)
	5	.....	.....	1.50 (51)	1.25 (53)	1.35 (54)	1.30 (262)	1.64 (143)
	6	.....	.....	.....	1.34 (24)	1.46 (94)	1.49 (244)	1.59 (502)
	7	.....	.....	.....	.....	1.55 (5)	1.67 (32)	1.65 (330)
	8	.....	.....	.....	.....	.....	.....	1.84 (19)
	9	.....	.....	.....	.....	.....	.....	.....
	10	.....	.....	.....	.....	.....	.....	.....
	11	.....	.....	.....	.....	.....	.....	.....
	Total	.....						

*Figures in parentheses show numbers of offspring on which the averages in each case are based.

I therefore regard as unsubstantiated the genotype conception of heredity in which unit-characters are regarded as indestructible and unmodifiable entities. Organisms are not devoid of variability; neither are the unit-characters which they manifest devoid of variability, nor yet is the germinal basis of such unit-characters devoid of variability. Unit-characters may arise gradually as the result of repeated selection in a particular direction.

I have dwelt thus at some length upon this question because of its theoretical and practical importance. If unit-characters are immutable, then straight selection is a waste of time, and the only procedure for the breeder well worth while is to hybridize and thus seek new combinations of unit-characters. This view has been repeatedly presented in recent years, but has met with scant favor at the hands of experienced animal breeders.

Experienced breeders, to be sure, are not qualified to pass final judgment on a theoretical question, but a theory which will not work out in practice needs careful scrutiny; there is surely something wrong with it. If, however, unit-characters are modifiable, then selection is of value not only in the isolation of particular combinations of units, but also in the improvement of the units themselves.

Mendel's law, in its broad general features, does stand the test of practice. It represents a fundamental general law of heredity. Many of the characteristics of animals and plants are transmitted substantially as units and are therefore capable of recombination in the form of new varieties through the agency of crossing. By apply-

Average Grade of Offspring in Minus Selection Series.

of parents.								Number of offspring.
2	2.12	2.25	2.37	2.50	2.62	2 75	2.87	
.....	.....	.....	.....	.....	.....	.....	.....	55
.....	.....	.....	.....	.....	.....	.....	.....	132
.....	.....	.....	.....	.....	.....	.....	.....	195
1.36 (9)	.....	.....	.....	.....	.....	.....	.....	329
1.52 (109)	1.80 (5)	.....	.....	.....	.....	.....	.....	701
1.58 (283)	1.52 (85)	.....	.....	1.82 (11)	.....	.....	.....	1,252
1.72 (969)	1.74 (260)	1.93 (41)	1.62 (4)	1.88 (15)	2.28 (18)	1.87 (6)	.....	1,680
1.78 (1170)	1.85 (377)	1.87 (36)	1.87 (30)	1.85 (17)	1.66 (6)	.....	.....	1,655
1.90 (811)	1.93 (403)	1.93 (148)	1.91 (175)	2.07 (53)	.....	.....	.....	1,591
1.95 (473)	2.00 (469)	2.04 (197)	2.06 (104)	2.13 (67)	2.16 (49)	1.97 (27)	2.19 (20)	1,406
2.08 (48)	2.14 (149)	2.15 (144)	2.18 (117)	2.24 (45)	2.09 (19).	2.33 (16)	1.95 (5)	543
.....								9,539

ing Mendel's law to specific cases one is able to predict with a considerable degree of accuracy what combinations will result from a particular cross and in what proportions these will be produced. Such a practical test is the best possible evidence of the correctness of a theory. Mendel's law throws light on each of the generalizations of empirical animal breeding previously enumerated:

It throws light on those recognized exceptions to the generalization that like begets like, and shows under what circumstances those exceptions are to be expected.

It shows why and when pedigree counts, and under what circumstances a knowledge of pedigree is of no consequence whatever.

It shows why inbreeding brings uniformity of type, and crossbreeding destroys it.

Mendel's law is then a first step toward the establishment of a *science* of animal breeding. But it is only a first step on a long and weary road, and we must be careful not to misinterpret or misapply it. Otherwise we are liable to be turned aside from the direct road of progress. We must not, for example, conclude on insufficient evidence that unit-characters possess an immutability which organisms do not possess. It is the purpose of this paper to insist on this point. Further we are not yet warranted in concluding that all inheritance is unit-character inheritance. A too sweeping generalization of this sort may also lead us astray. Let us proceed with enthusiasm, but with caution, noting well our landmarks.

The practical utility of Mendel's law is much greater to the plant

breeder than to the animal breeder, because the plant-breeder is concerned largely with the production of a very few first generation or second generation hybrids of merit, which are then multiplied indefinitely by asexual means or self fertilization. In the case of the domesticated animals such methods of multiplication are impossible. Every individual produced has two parents, and purity of race in the parents is indispensable to uniformity of type in the progeny.

As a theoretical foundation principle Mendel's law is equally valuable to animal breeders and to plant breeders.

HORSES AND HORSE BREEDING[a]

H. K. BUSH-BROWN

Washington, D. C.

In a former article published in the *American Breeders Magazine*, I suggested that the best race horses, both trotters and runners, be studied anatomically in their living active form, and from the skeleton after death, as a means of mathematically determining what differences there are in structure. This would enable us to not only establish a method of defining types but also to ascertain which structural propositions are the most favorable to speed and endurance, and in what way the runner differs from the trotter. Every horseman recognizes the differences of proportion at a glance and by instinct, but so far as I know they have not been reduced to mathematical and comparable terms.

No one will question that the separate types of horses which we breed and keep for specific purposes, are the results of selective breeding, and that the differences between breeds are largely a matter of differences in the proportions of the structure of the skeleton. And this suggests the need of an accurate and reliable method of measuring the bodies of individuals, which will make full allowance for variations in size, so that not only large and small individuals of the same breed may become comparable, but also individuals belonging to different breeds, and even the same individual in different stages of growth. Such a method must clearly be based upon a unit common to all individuals, and upon a comparison of proportions rather than upon absolute measurements.

[a] This is the second article of the series on Horses and Horse-Breeding begun by the author in *American Breeders Magazine*, vol. II, no. 2, and no. 3.

I therefore submit to the consideration of animal breeders a system which I have devised after much study and experimentation. It is as follows:

The height of the horse at the withers is divided into three equal parts denominated "heads"; in order to facilitate closer measure-

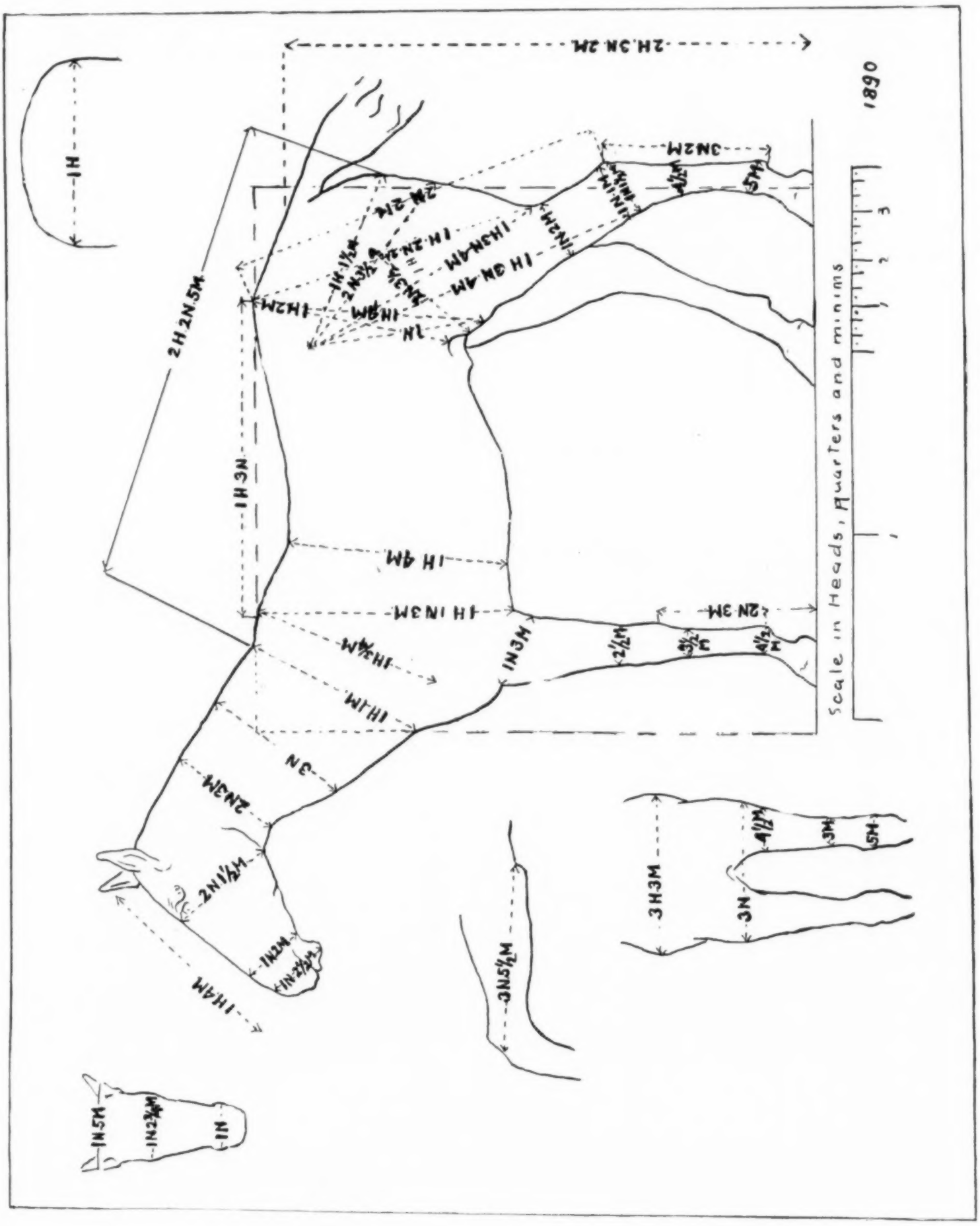


FIG. 1—WOOLSEY.
Sixteen hands, ¾ inches.

ments the "head" is divided into four further parts, called quarters; each quarter is divided into six parts called minims. In the diagrams Figures 1 to 5 these denominations are abbreviated H for "head;" N for "quarter" and M for "miñim." By this scale, no matter what

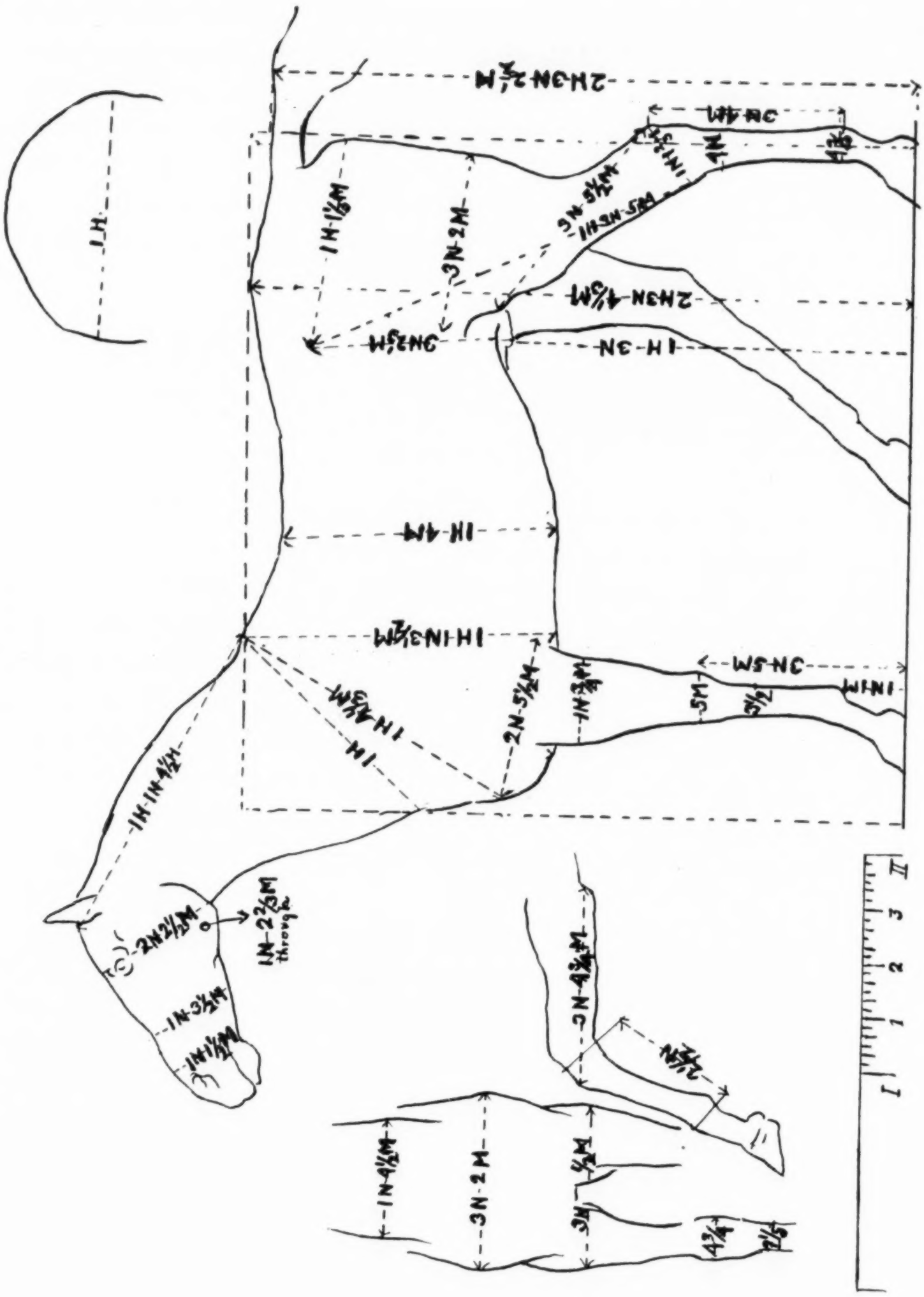


FIG. 2—LEOPARD.
Fourteen hands, 3 inches.

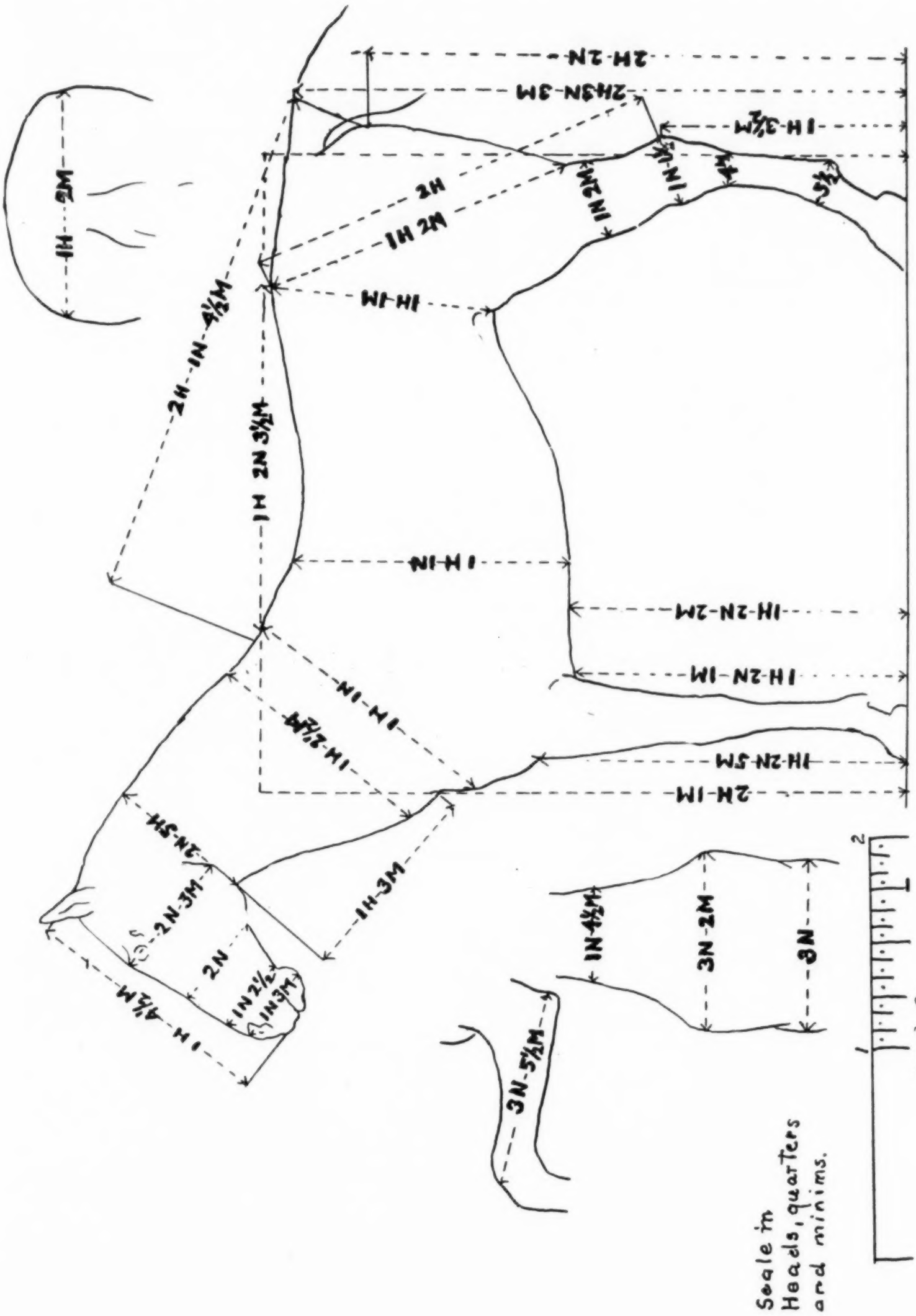


FIG. 3—ETHAN ALLEN 3D.

Fourteen hands, 3¾ inches high, 15 hands, 2 inches long.

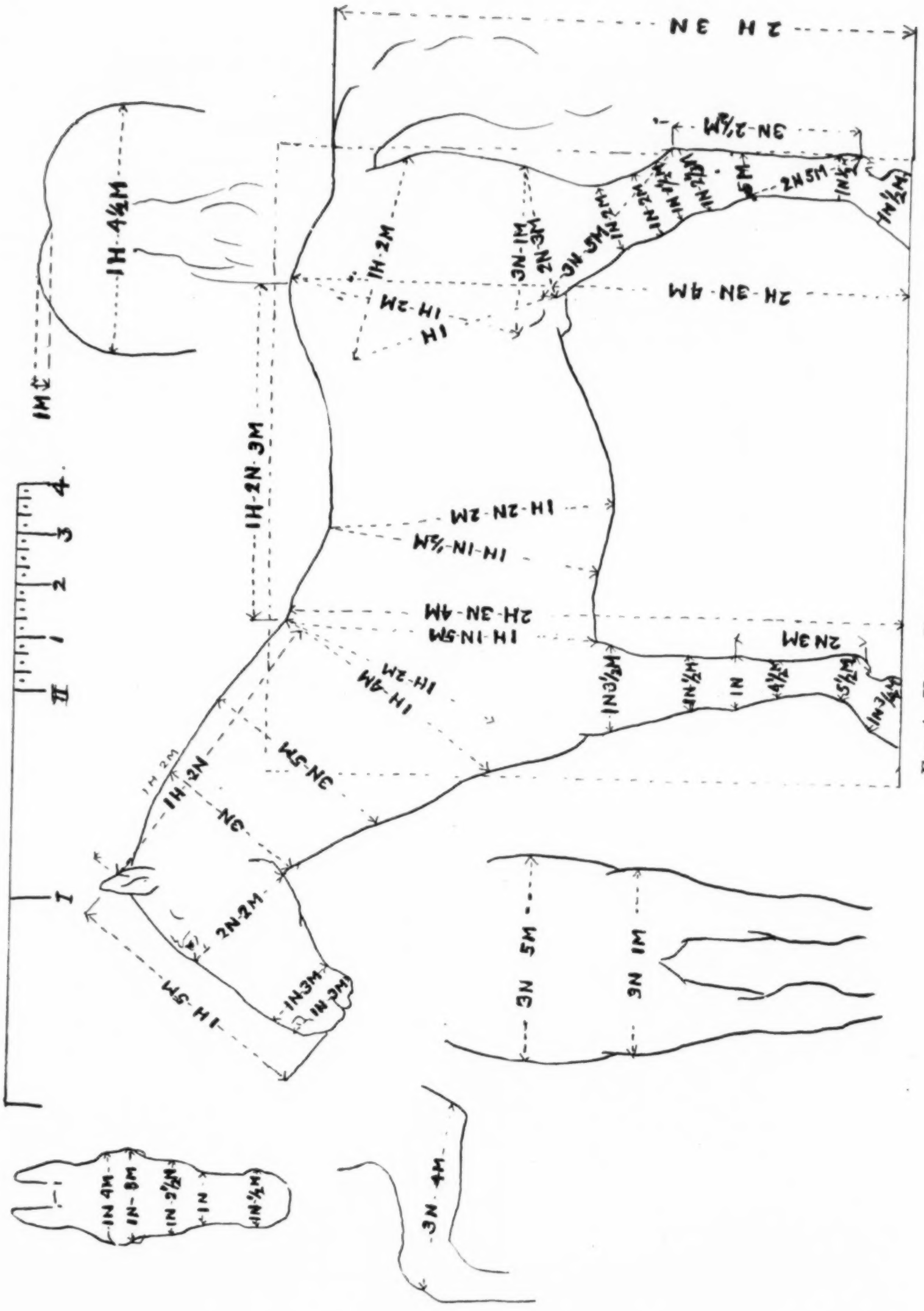


FIG. 4—HONS FLEUR.
Imported Norman, 17 hands, 1½ inches.

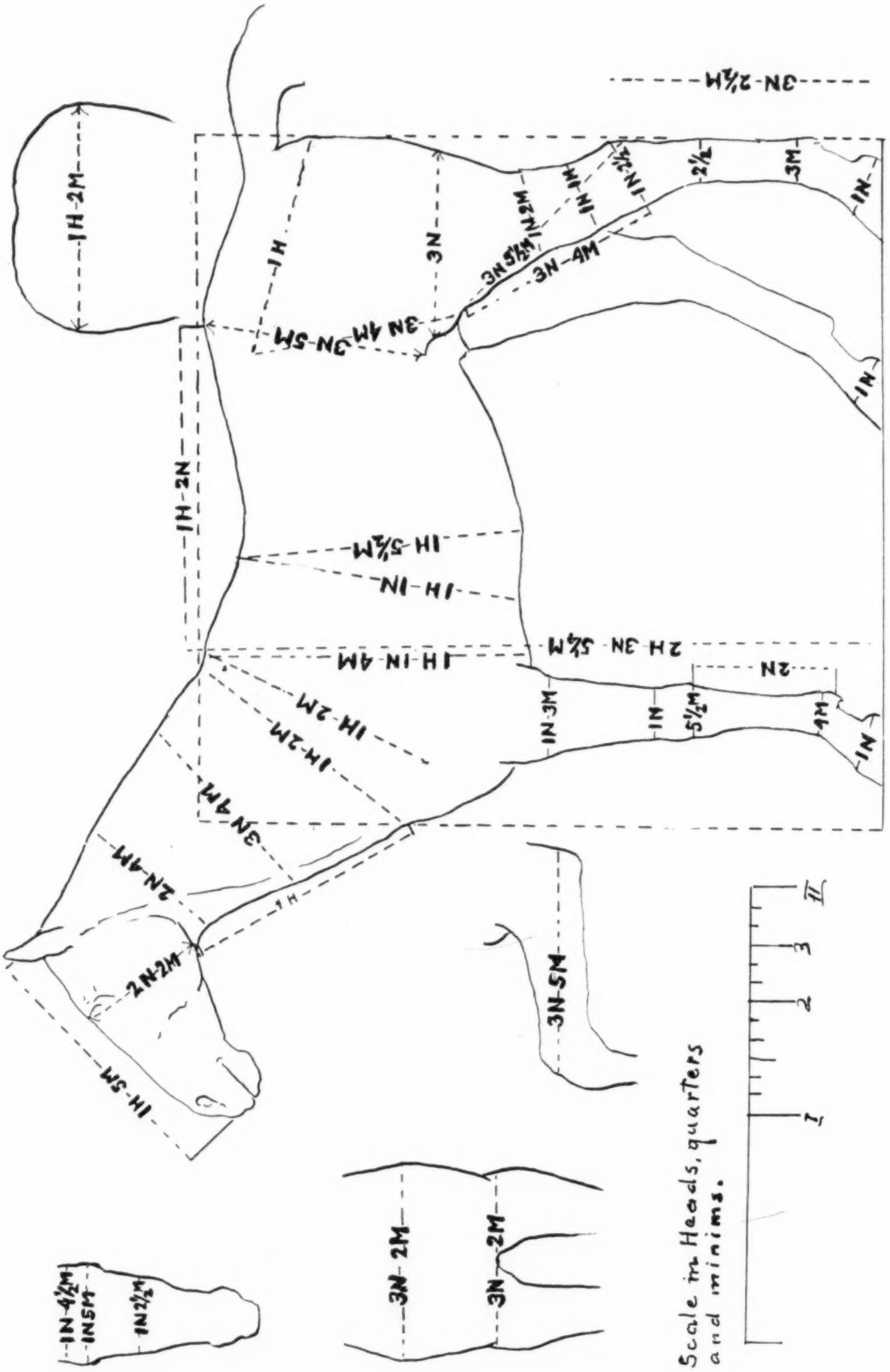


FIG. 5—RED LION.

Throughbred Dam, Imp. Hons Fleur, Norman Sire, 17 hands, 1¼ inches.

size the individual is, his own height determines the unit of his measure. By setting down all the actual proportion measurements, on this scale, an exact record of the form and structural peculiarities of an animal may be obtained which may be available for comparing other individuals, whether living or dead. With help of those proportion measurements a sculptor or painter can reproduce an exact form of some one individual horse, in drawing or painting or in model in any size.

A system of absolute measurements is of no value whatever when we come to compare individuals of different sizes, even within the same breed. Similarly, a comparative measurement based upon the circumference of an animal, as unit, is of little value. On the other hand, by means of the system of measuring as outlined above, the exact outline, as presented to the eye from any given point of view, can be reproduced.

By determining what constitutes the perfect type of Thoroughbred, Morgan, Trotter, Percheron or other breed whatsoever, each horse in his own type, can be measured and standards of proportion be established for that type. If the breeders would work this out on an agreed system, the judges in a show ring would have an exact mathematical test to assist their judgment as formed by visual comparison and experience.

To illustrate the manner of using this method, the proportion-measurements of "Woolsey" are given in Figure 1. Woolsey was an old time trotting sire, the full brother of Sunol.

For purposes of comparing breeds, I add the measurements of the imported Arab, Leopard, presented to General Grant by the Sultan of Turkey, Figure 2; Ethan Allen 3d, a typical Morgan, Figure 3; Hons Fleur an imported Norman, Figure 4, and also of Red Lion, Figure 5, a cross bred son of the latter from a thoroughbred dam.

The same system of measuring may be applied to cattle, but a cow's body does not fill a square as does a horse; so instead of taking the height of the cow at the withers it is necessary to take the length from the front of the shoulder to the end rump bone or illium, and divide this length into three and this into quarters and minims the same as for the horse. With this scale the cow will be found to be as harmoniously proportioned as the horse, and to be one-half a head lower at the withers than the horse.

I am inclined to believe that the reason why the large number of records of measurements of individual cows, massed in the herd

books of the Holstein Friesian Association have been difficult to digest and to utilize for statistical work, was that all these measurements were absolute and therefore not comparable except in averages compri-ing large numbers of cows. This system of notation of proportions applied to a large number of cows would furnish us most exact data on the question of form and function, and would enable us to determine whether, and if so in what particular, of form of physical conformation or of type the 14 pound cow differs from the 20, 25 and 30 pound cow. All measurements, so far made on growing cattle from calfhood to maturity, have given no positive results because the data concerning even the same individuals were not comparable.

With this scale standard types of cattle can be established by averages or otherwise the same as has been suggested for horses. I have measured the stuffed specimen of a giraffe and find that the length of his head bears the same relation to the length of his body as is found in the horse. It would be interesting to know to how many mammals this system of measuring can be made to apply.

COMPARISONS OF YIELD BETWEEN HYBRIDS AND SELECTIONS IN OATS[a]

DR. H. H. LOVE

Ithaca, New York

The purpose of this paper is to set forth the results of some attempts to improve the oat crop by selection and hybridization. This work has been under way at the Cornell Experiment Station for the past five years. The hybrids and selections were made by Mr. J. B. Norton, of the United States Department of Agriculture. The preliminary work was done in Illinois but on accepting a position in the Plant-Breeding Department of the Cornell Agricultural College, Mr. Norton brought a set of the hybrids and selections to New York. After a year at Cornell Mr. Norton returned to the Bureau of Plant Industry and the testing of the hybrids and selections has been left for others to do. The writer has had charge of the work for the past four years.

The work originally consisted in planting rows, a rod in length, of the different strains and repeating the series on a different type of soil. Later, however, the different strains were planted in rod-rows

[a] Paper No. 31, Department of Plant-Breeding, Cornell University, Ithaca, New York.

and the rows repeated a number of times. The rod-row system is used by this department for all small grain work. Some of our results were furnished Dr. T. L. Lyon, of this Station, to compare with some plat tests and it was found that the rod-row repeated a number of times is apt to be more nearly correct than a large plat repeated only once.

The following varieties and combinations were represented in the hybrids and selections tested:

Series.	Hybrids.	Series.	Selections.
27	Garton's Tartar King × Clydesdale	62	Sixty Day
31	Burt (Early White) × Texas Red Rustproof	63	Burt (Extra Early)
		120	Silver Mine (Great Dakota)
32	Burt (Early White) × Early Champion	123	Welcome
34	Burt (Early White) × Sixty Day	132	Sixty Day
42	Asia Minor Rustproof (3676) × Clydesdale	137	Early Champion
		138	Early Champion (Prosperity)
49	Sixty Day × Clydesdale	5938	Sixty Day
50	Sixty Day × Probsteier		

The strains showing the highest yield in 1907 and 1908 were sown in a larger number of rows in 1909, in order to give them a fairer test. These strains were also repeated in 1910 and 1911. In the following table the ten best selections and hybrids are shown with their average yields for the three years. This table includes only strains which have been tested 5 to 8 times in 1909, 8 to 13 times in 1910 and from 15 to 21 times in 1911.

Three year average, 1909 to 1911.

Hybrids.		Selections.	
Pedigree No.	Average yield bushel per acre.	Pedigree No.	Average yield bushel per acre.
31a1-16-1	51.7	132-2	47.3
34a1-24	51.8	62-II-17-1	49.4
49a2-18	52.1	63-1-4	49.5
49a1-27-1	52.4	62-II-6-3	51.1
50a1-22	53.1	62-II-6-2	51.1
49a2-13	53.6	62-II-18-1-1	54-5
49a2-20	54.0	5938-1	54.6
49a2-22	54.3	123-5	57.3
50a1-10	55.0	120-9	57.7
34a1-11-2	62.1	62-II-18-3	58.6
Average	54.0	Average	53 1

This shows an average yield of 54 bushels for the hybrids and 53.1 bushels for the selections. The highest yielding strain for the three

years is a hybrid, while the three strains ranking next in order are selections.

It seemed desirable to know how these new sorts would compare with some of the well known commercial varieties and such a test was begun in 1910 and continued in 1911. The seed of the commercial varieties was obtained from different seed houses. The hybrids and selections, together with the commercial varieties were sown in rod-rows and these rows repeated usually 21 times. The results for the ten best hybrids and ten best selections, together with the results for the 8 best commercial varieties, are shown in the following table:

Two year average, 1910 and 1911.

Hybrids.		Selection.		Varieties.	
Pedigree No.	Average yield bushel per acre.	Pedigree No.	Average yield bushel per acre.	Name	Average yield bushel per acre.
49a2-13	55.5	62-II-17-1	53.0	Black Tartarian	40.7
34a1-32-1	56.0	5938-1	53.5	Golden Giant Side	42.3
34a1-28-2	56.9	63-1-4	54.2	White Tartar King	45.5
49a2-16-10	57.4	62-II-6-3	54.9	Welcome	47.8
49a2-18	57.9	62-II-6-2	55.0	Swedish Select	52.0
50a1-10	58.3	33a1-15	56.0	Danish Island	54.0
50a1-22	59.6	120-9	62.3	Silver Mine	61.4
27a1-31	60.3	123-5	62.6	Lincoln	62.4
49a2-20	61.7	62-II-18-3	64.3		
34a1-11-2	66.5	62-II-18-1-1	65.1		
Average	59.0	Average	58.1	Average	50.8

This table shows an average yield for the hybrids of 59 bushels per acre, for the selections 58.1 bushels per acre, and for the eight best varieties 50.8 bushels per acre. The analysis of this data also brings out the value of certain classes of hybrids and selections and the value of certain varieties, as a basis on which to start improvement.

Among the 10 best hybrids, 4 are from series 49, 3 from series 34, and 2 from series 50. Series 49, as is shown in table, is a cross between Sixty Day and Clydesdale; series 34 is a cross between Burt (Early White) and Sixty Day; and series 50 is a cross between Sixty Day and Probsteier. Thus 9 of the best hybrids have Sixty Day as one of the parents which shows the value of this variety in these combinations. This variety also shows its value in the selections, for 6 of the 10 best selections are from this variety. No doubt for other localities and other environments there will be found certain other varieties which will be just as valuable for selection work or hybridization. Another point of interest is whether the hybrids or selections prove themselves

the better yielders. Considering the 10 best hybrids and selections in each case, the averages for 1909 and 1910 favor the hybrids, while for 1911 the conditions are reversed. The three-year averages and the two-year averages show for the 10 best an advantage for the hybrids of about one bushel in each case. In each year, however, the best selection yields better than the best hybrids from 1.3 to 5.9 bushels per acre, yet the three-year and the two-year averages give respectively an advantage of 3.5 and 1.4 bushels to the best hybrid over the best selection. The same hybrid is best in the three-year and in the two-year averages, while the best selection in the three-year average is second best in the two-year average.

In 1907 the tests of all hybrids gave an average of 49.19 bushels per acre, while the average of all straight selections gave a yield of 52.64 bushels per acre. In 1908 the calculated average yield per acre of all hybrids was 56.2 bushels and of all straight selections 48 bushels. In 1909 the average yield of all hybrids was 33.6 bushels per acre, while that of all straight selections was 26.9 bushels per acre. For 1910 the average yield of all hybrids was 65.9 bushels per acre, while that of all selections was 54.2 bushels per acre. For 1911 the average yield of all hybrids was 45.8 bushels per acre, of all selections 48.7 bushels per acre. The average for the five years was for the hybrids 50.14 bushels per acre and for the selections 46.09 bushels per acre. The average for the five years shows that the hybrids gave a higher yield than the selections and seems to indicate that as far as yield is concerned the hybrids are better, on the average, than the selections.

The data thus far obtained furnishes considerable evidence on the value of different classes of hybrids. It would seem that the most promising combinations of those tested are the Burt crossed with Texas Rustproof, Burt crossed with Sixty Day, and Sixty Day crossed with Extra Early Burt. These conclusions cannot be taken as absolute, as other combinations than those tested might turn out more promising.

These results show the possibilities of improving the oat crop by the selection of good plants from a variety or by the combination through hybridization of the desirable qualities of different varieties and thus obtaining a strain of superior value, and it is hoped this article will create sufficient interest to induce plant breeders and careful grain growers to follow this line of work.

THE SIZE OF THE SEED PLANTED AND THE FERTILITY OF THE PLANT PRODUCED

J. Arthur Harris

Cold Spring Harbor, Long Island, New York

In the practical growing of animals and plants both breeding and feeding are factors of great significance. In our enthusiasm over the possibilities of the newer methods in genetics, we are apt to forget that there must be limits to the improvements of the innate racial qualities which can be attained by hybridization or selection. These limits once reached, we are thrown back upon refinements in culture and feeding—upon the physiology of the individual as contrasted with the germinal constitution of the race—for further margins of improvement.

For these reasons, I have always planned my breeding experiments to obtain incidentally as much information as possible on the strictly physiological factors influencing yield. Such factors are, for example, the influence of the environment of the parent plants furnishing the seed planted[a] upon the characteristics of the offspring, the influence of the size of the seed planted, etc.

The purpose of this note is merely to explain a diagram illustrating the importance of one of these physiological factors, namely, the weight of the seed planted, in determining yield.

The data for the diagram are drawn from twenty experimental crops of garden beans, involving Navy, White Flageolet and Ne Plus Ultra, represented by many thousands of individuals. The scale at the bottom shows the range of variation, of the weight of the seed planted, in units of 0.025 gram.[b] The vertical scale on the left hand side shows the mean number of pods per plant. The height (on the latter scale at the left of the diagram) at which the twenty sloping lines cut the ordinates (vertical lines) erected on the weight classes, gives the smoothed mean number of pods per plant for that weight of seed.

The actual means are of course very irregular, since the bean plant is very sensitive to its environment, for in ordinary field cultures, uniform conditions cannot be given. Moreover, exact agreements of the empirical and theoretical means are never secured because of the

[a] See "A First Study of the Influence of the Starvation of the Ascendants upon the Characteristics of the Descendants. I–II." *American Naturalist*, vol. 46, pp. 313–343, 656–674, 1912.

[b] That is, class 3 = 0.050 to 0.075, or a mean of 0.0625; class 4 = 0.075 to 0.100; class 5 = 0.100 to 0.125; class 24 = 0.575 to 0.600.

errors of sampling common to all statistics.[c] Of course, the lines as given here are to be looked upon merely as a conventionalized representation of the increase in mean number of pods per plant associated with an increase in the weight of the seed planted. But, considering the difficulties inherent in the materials, they are very accurate conventions.

The twenty series not only represent three distinct varieties but were grown under widely varying conditions and show in consequence

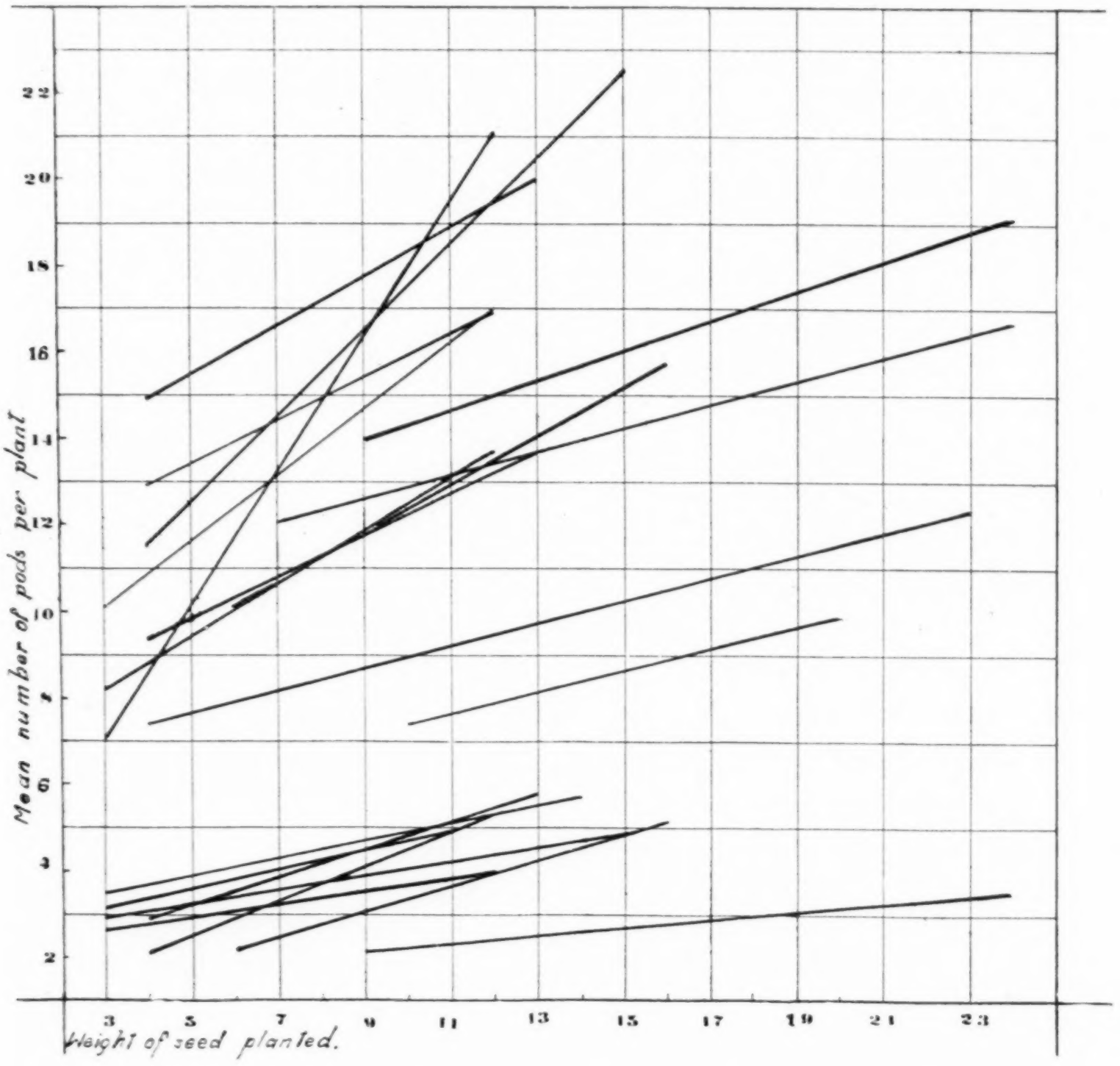


DIAGRAM ILLUSTRATING INFLUENCE OF WEIGHT OF SEED UPON THE YIELD

great differences in the slope of the lines which express in concrete terms the mean number of pods per plant. Yet, in every case there is a conspicuous gain by the planting of heavier seeds.

Considerable attention has already been given by experiment station workers to the question of light and heavy seed, with the general

[c] Full details are given in a paper in vol. ix, part I of *Biometrika:* "On the Relationship Between the Weight of the Seed Planted and the Characters of the Plant Produced. I."

result that the heavier seed gives the heavier yield. But generally, the lighter seeds have been separated by fanning and in many cases included blighted or shrivelled seeds. Here all seeds were perfect, as far as could be determined by individual examination.

The practicability of seed grading depends entirely upon the ratio of the cost to the returns from the increase in yield thus secured. These are problems which practical men must figure out. The purpose of this note will have been fulfilled if it suggests to the breeder the importance of planning his work so as to take more fully into account than is generally done, the purely physiological factors.

TEN YEARS OF CORN BREEDING

EUGENE D. FUNK

Shirley, Illinois

That little kernel, corn, capable of springing forth into a beautiful living plant and growing to a height of twelve or more feet within the short period of ninety days, and what is greater still, to be able to reproduce itself over 1,000 fold during one short season, surely we ought to talk more about it, to study its characteristics and habits until we have learned many things yet unthought of. The farmer of the corn belt has scarcely begun to realize the possibilities and necessities that lie before him in order to meet the future demands for corn.

No two ears of corn are exactly alike, yet it is found that within varieties there exist certain strains or families. Breeding corn is simply carrying out nature's own methods, but in addition one must keep a record of each individual plant or set of plants resulting from certain ears. By selection we are enabled to increase certain desirable qualities and thus we bring about the tendency of each succeeding generation to become more uniform and fixed in its certainty to reproduce these qualities.

What the ear-to-row method reveals.—On planting the kernels of corn from a given mother-ear in a single row, that row of progeny will invariably have a certain degree of individuality throughout the season and show a contrast with other rows similarly planted. It may be that this particular row will germinate almost perfectly, outgrow the neighboring rows completely and at gathering time having ears of uniform size and few nubbins outyield all others in the field. Yet the selection of the original ears for planting may have been made with the greatest care to have them all as nearly uniform as possible.

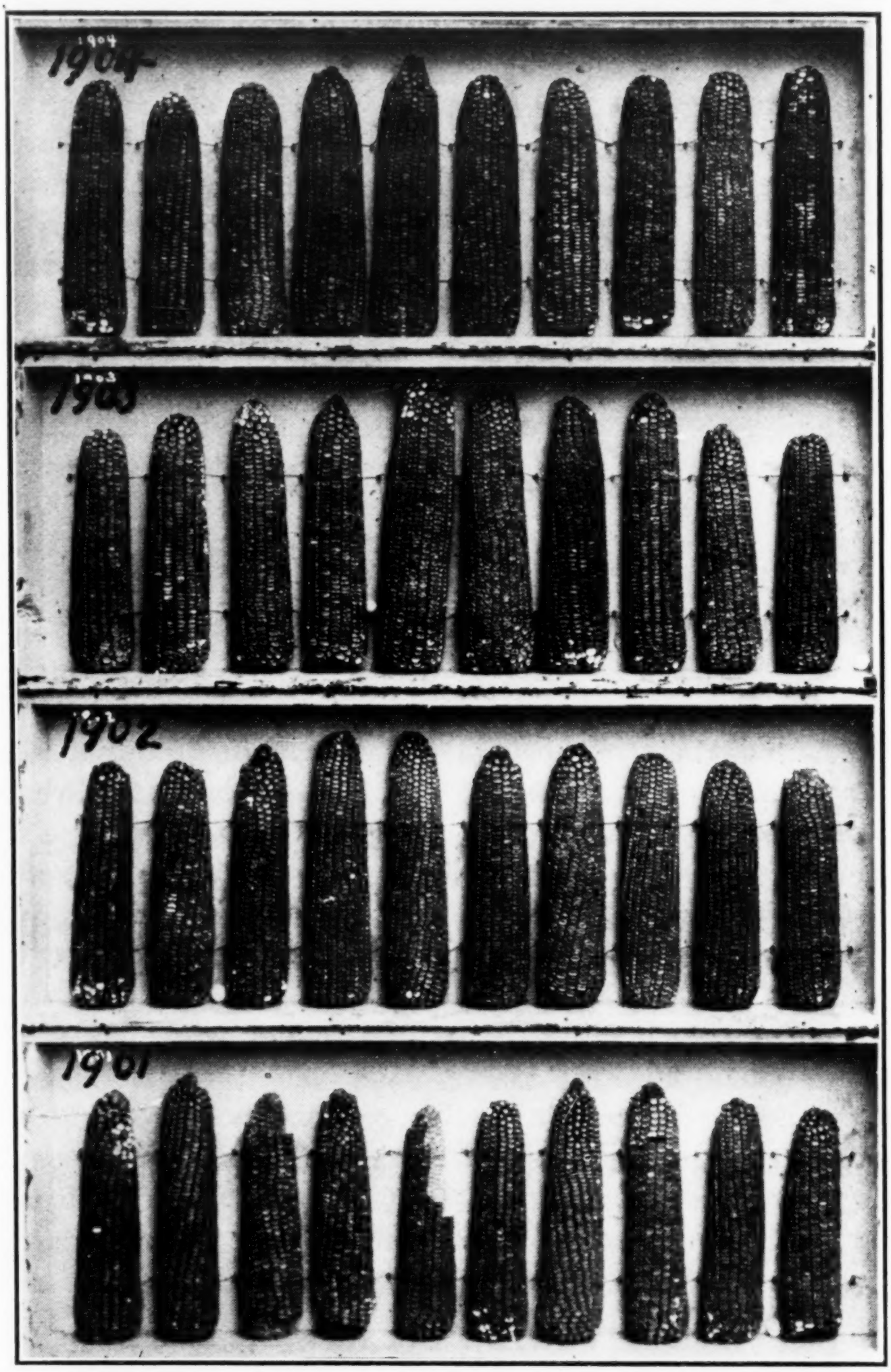


FIG. 1—REPRESENTATIVE SAMPLES OF SEED CORN SELECTED FOR PLANTING IN THE YEARS 1901 TO 1904

For ten consecutive years there have been carefully put in a hermetically sealed can—a bushel of Leaming corn representing the seed selected for planting on about 160 acres. Each of the ten-ear lots, shown in the illustrations, figures 1 to 3, represents the seed selected for planting in their respective years and so these are not the ten best or the ten poorest ears, but as nearly as possible a true representation of the whole.

In order to obtain the very best seed that could be found from the crop of 1901, Prof. P. G. Holden and Dwight Funk visited several of the best corn breeders of that time to obtain seed ears, and the sample marked 1901 shows this corn. The eleven samples show the improvement which has been wrought from year to year by selection.

It would not be fair to say, concerning the increase in yield, that the 62-bushel crop of 1902 and the 85-bushel crop of 1911 is a correct comparison because the soil used was better and more fertile in 1911.

The treatment through the season for each row may be identically the same and the chances for any variation in fertility of the soil reduced to the minimum. The very next row to this vigorous and high yielding row of corn may represent the opposite extreme, poor germination, weakly, perhaps of a pale green color through the season and giving a very small yield. Notes are taken of these different rows of corn during the growing season. Previous to the time of pollenization all tassels of weak and undesirable stalks are removed to prevent the pollen from the inferior stalks fertilizing the more vigorous plants. All ears and rows bear individual numbers which are recorded in a book especially prepared for this purpose. Each row is husked separately and the corn weighed. By this means we secure the yield per acre of the progeny of each mother ear.

From the rows yielding at the highest rate per acre, thus showing their mother ear to have the highest producing power, we save the best corn for the next year's breeding plot. These ears are selected from hills which contain three stalks in order that each ear selected may have been grown under the same conditions. From these same best rows, seed is also saved for larger fields of from five to ten acres, which we call multiplying plots, the yields of which are carefully noted.

Making the performance record.—The yields, first of the mother plants, then of the multiplying plot and then the larger fields become the performance record of the strain of corn, the same as the individual track record of his progeny becomes the record of the trotting horse.

The results for the first few generations, while we may have large yield composed of all sorts and sizes of ears—hybrids from many hundreds of other plants—we find comparatively few ears equalling or excelling the mother ear. But these are the ears selected for future propagation and improvement and after the type is once fixed, we may expect a reasonable uniformity in the progeny of succeeding generations. Corn breeding is not necessarily the getting of typical beauty of ears, or perhaps a few ears and the rest nubbins, but it is to produce corn that will increase an average yield of 28 or 29 bushels per acre to an amount that will justify the labor and expense and that farmers have a right to hope for.

Yield per acre is the unit, the all essential point in which the farmer is most interested. The score card, the corn shows and the competitive corn judging are all good and have their place in awakening the interest to better and more profitable corn raising. The commercial corn breeder should not allow himself to become too greatly absorbed

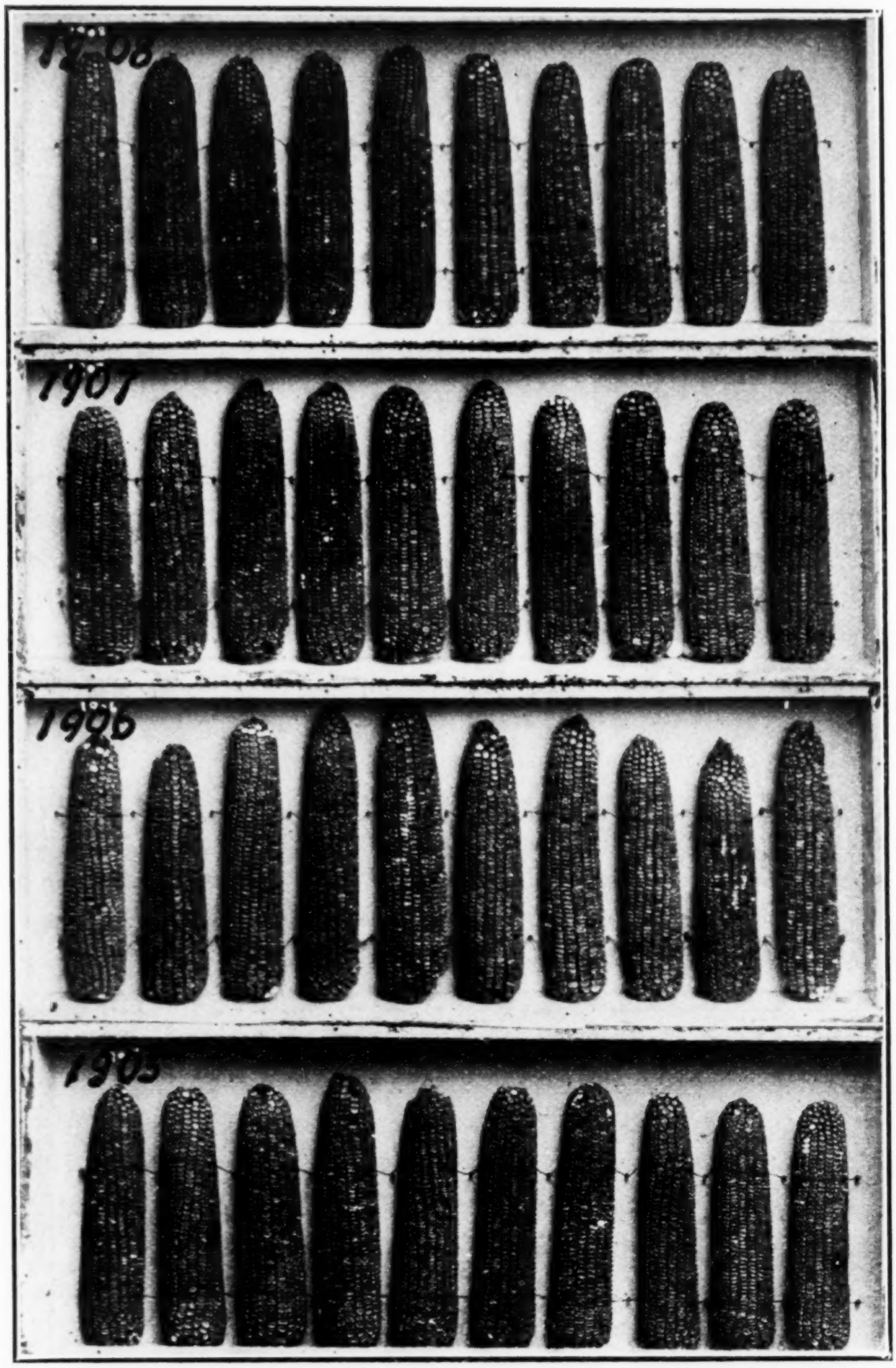


FIG. 2—REPRESENTATIVE SAMPLES OF SEED CORN SELECTED FOR PLANTING IN THE YEARS 1905 TO 1908

in ideal ears, unless these can show for themselves by authenticated records prepotent powers in reproduction. Dr. H. J. Webber, of Cornell University, advises in plant breeding to stick closely to the important characteristics and not to give weight to features not of practical value. Apparent but slight deformities will eventually take care of themselves, or may be improved. Personal experience has abundantly proven this to us, for some of our highest yielding

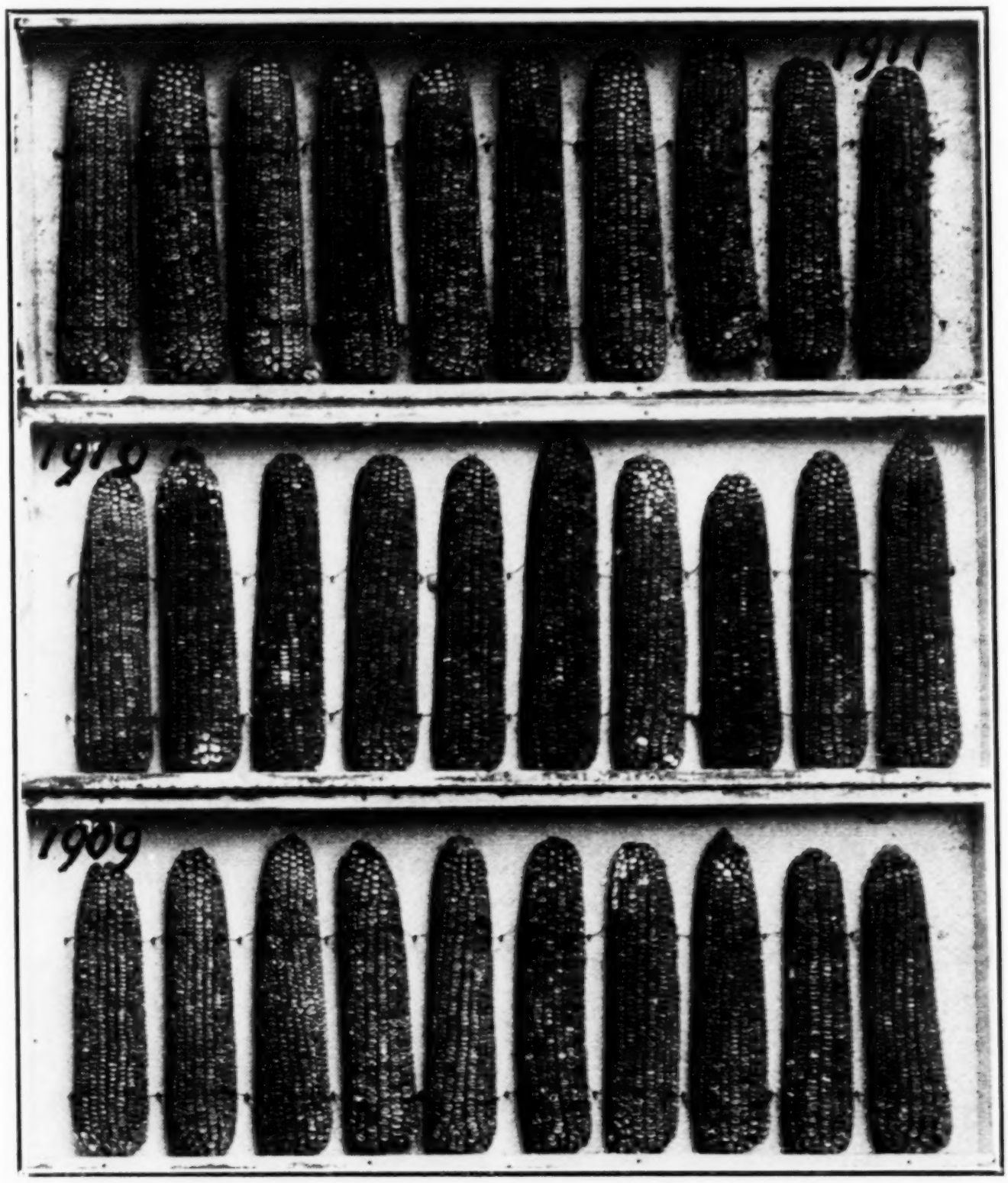


FIG. 3—REPRESENTATIVE SAMPLES OF SEED CORN FOR PLANTING IN THE YEARS 1909 TO 1911

strains of corn today are anything but ideal ears from the standpoint of the score card.

Theoretically a mother ear should be cylindrical, with well filled tip and butt, wedge-shaped kernels close together at both crown and next to the cob. The kernels should be of as nearly uniform size as possible in order that the planter may drop a given number of grains

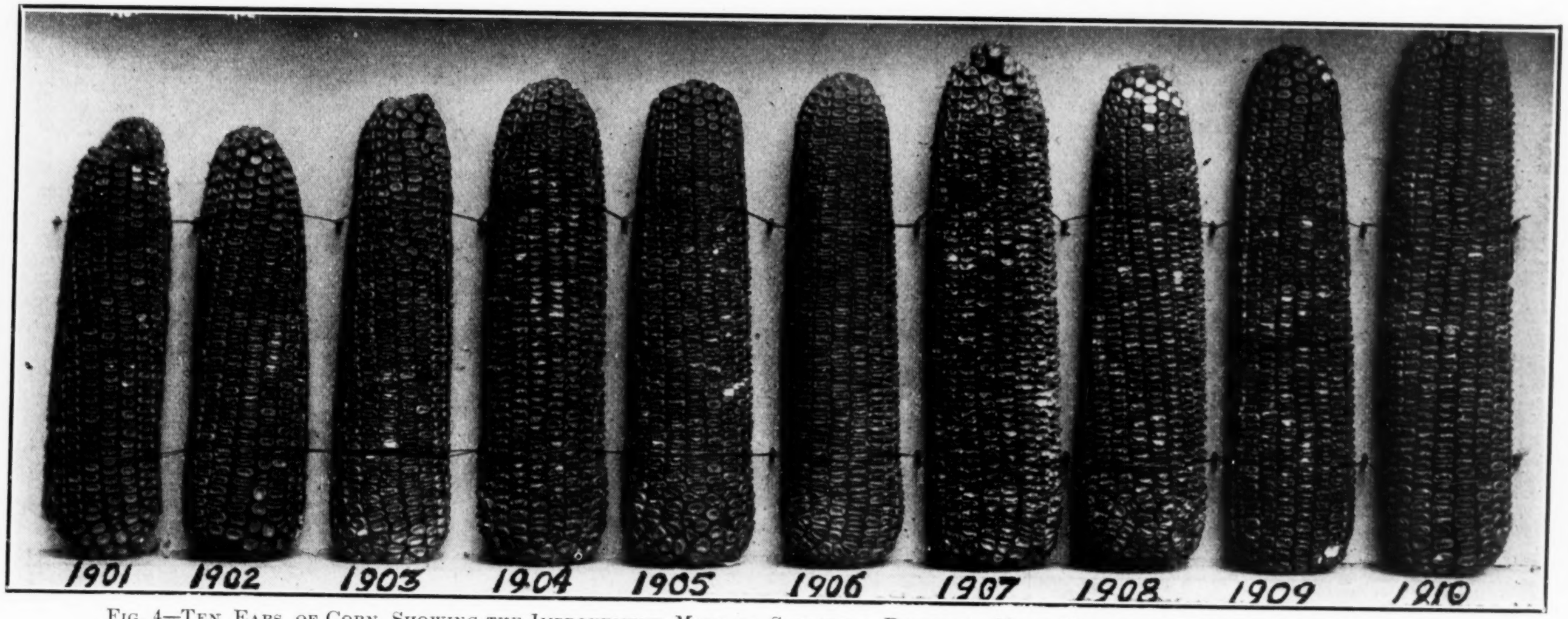


FIG. 4—TEN EARS OF CORN SHOWING THE IMPROVEMENT MADE BY SELECTION DURING AS MANY YEARS, THE SEASONS FROM 1901 TO 1910

Each ear represents the average of the selected progeny for the crop of that year

in each hill, thus securing an even and perfect stand of corn. But in front of all this, there must be a performance record. In other words, a pedigree of what the ancestors of this strain of corn have been capable of doing. Seed coming from ordinary looking ears but possessing such strains of inherent power as to produce a medium size ear on a maximum number of stalks, is certainly far superior for the farmer to plant than the finest show corn that was ever at a corn show which has been selected merely from the point of beauty and the ideal score card. This is not saying that nothing can be accomplished by physical selection alone, and the planting of seed from good, symmetrical ears. A great deal can be accomplished both in the improvement of type and to certain extent in yield.

Now comes the most interesting point. While we have maintained this selection for type and uniformity, in our breeding plots for highest yields, an entirely different type of the same variety of corn has gradually become prominent. Here the selection is largely governed by the predominating type of the seed corn gathered from the highest yielding rows and by comparison with the type of the mother ear. After a selection of ten ears from some of our highest yielding strains of Funk's Gold Standard Leaming and Funk's Yellow Dent, it is most striking to observe, that both varieties show a tendency toward the same type and neither of them conform to the present score card or our arbitrary selection of type for a perfect ear. In general the increase has been about fifteen bushels to the acre. Several hundred farmers, who have planted this seed in practically all of the corn growing sections of the world, agree that the increase in yield over the ordinary selection by the average farmer is from five to twenty bushels and in many cases more per acre. This compares favorably with our check plots. A series of experiments showed that six years out of seven the smooth type of corn made the highest yield, and in another case the same was true five out of seven times.

I wish it were otherwise and that we could discover some relation of idealism to high yield. I anticipate the question that if like produces like why should we not be able to reproduce a lot of fancy and high scoring ears? We may produce them, but we have to use a somewhat different method, and in so doing we fail to get the largest yield. A great many farmers are making a mistake in demanding too large an ear for a seed ear. This throws the corn too late in maturing, even during an ordinary fall a large proportion of the stalks with large ears are caught by the frost; large ears are not really necessary for a bumper crop of corn. I have a report of an average of 106.8

bushels per acre of corn grown in Minnesota, with Minnesota No. 13 seed. And with what we would consider a nubbin in Illinois, Jerry Moore of South Carolina grew 228 bushels on an acre none of the ears that he planted measured over $8\frac{1}{2}$ to 9 inches in length. Corn breeders should strive for a medium sized ear on a maximum number of stalks, and then they can grow all the corn that the fertility in the soil will allow.

PEDAGOGICS OF GENETICS

The teaching of the science of heredity and breeding, and the training of experts in plant and animal breeding and in eugenics, is rapidly coming into our system of education. The value of a study which peculiarly combines cultural with vocational values appeals to the student and will bring this subject rapidly into demand, as will also its interest as a phase of biology, which fascinates. Its vital relation to the economic production of farm products and therefore its relation to the cost of living, will make it attractive to students pursuing general and vocational courses not concerned primarily with genetics. Classes in genetics in our colleges and universities will be especially interesting and vital for those preparing for vocations which relate to eusthenic betterments.

Those universities and colleges which can employ special teachers have here a most unique opportunity to take the lead and place this subject upon a basis at once scientific, pedagogic proper and practical. The American Breeders Association appeals to these institutions to take on this important work much more rapidly. This Association took the lead in bringing the subject of eugenics under the guidance of a group of scientific investigators. Almost before we realized that it could be so the subject had passed into the stage of teaching and of propaganda. No small group of investigators can alone cope with these phases of the subject. The educators, physicians, preachers and philanthropists are now needed to do their part. Those who would lead must study the available literature.

Philanthropists who contemplate giving money to colleges and universities could do no better than to dedicate generous sums to the endowments of chairs of genetics. Legislative bodies should make substantial appropriations to their state agricultural colleges and state universities to establish and liberally sustain chairs of genetics.

EDITORIALS

GENETICS—A FIELD FOR THE SCIENTIFIC PHILANTHROPIST

When the American Breeders Association was organized nearly ten years ago it was in response chiefly to a need that was felt for conference among breeders and scientists, and to give stimulus to research work in the science of heredity and the art of breeding.

Subsequent events, as for instance the wonderful and exceedingly popular work of a number of plant breeders, and the oncoming Mendelian and DeVriesian thought, have made of genetics a remarkably practical, productive science. The recent and seemingly permanent rise in the cost of living, which is giving economists and legislators so much concern, has served to make immensely important and vital the increasing of food production through the developing of better breeds and varieties. The fact that one-half of the increased food production of whatever kind will eventually come through the use of better bred varieties of plants, cereals, fruits, and animals makes this matter of genetics or breeding the biggest proposition in agriculture, after soil conservation.

The work of the American Breeders Association has been carried on by a few sincere and devoted individuals, with such means as were raised by a membership consisting of scientists, practical breeders of plants and animals, of physicians, sociologists, social workers, ministers, officers of eleemosynary institutions, and men and women of affairs, all alert and interested. Through their efforts a new world of research has been opened. But what has so far been done, though a mere beginning, has afforded a glimpse of amazing possibilities. With these developments of a decade, the American Breeders Association has grown to an organization equipped with effective methods to attack some of the most vital problems facing the race in its progress. The Association has attracted a large number of scientists of other countries, and seems in a fair way to become international in scope.

The influence of the Association has made itself felt in numerous other ways. The plant breeder, a name and a man theretofore unknown, has come into public prominence; colleges and universities are establishing chairs of genetics; eugenics and genetic societies are being organized at intellectual centers; experiment stations are increasingly giving attention to the subject of experimental breeding; states, as Minnesota and New York, are organizing great establish-

ments for the breeding of their field crops; the former State has a farm for the specific purpose of breeding and originating fruit varieties.

All this work has been received by the public with an open-mindedness bordering on avidity. Its influence has gone forward so rapidly that it is in a fair way to overtake and swamp us because of our inadequate means of taking care of the new openings and demands. Having originated the movement, the Association feels the responsibility of directing it, that it may proceed along a sound and useful course, and to save it from falling into the hands of quacks, impostors, and half-baked scientists.

Several circumstances have favored us in the promotion of this educational propaganda in genetics, eugenics, animal breeding, and plant breeding. Chief among these is the greater public appreciation of out-door life, of nature and nature study. Recent years have seen the beginning of the "back to the land" movement among the more virile elements of the race; a keen and active interest in matters pertaining to farming and to country life is almost universal. Numerous books and magazine articles, the daily press, and even the stage, have drawn public interest to the questions of genetic race culture, and of the improvement of the heredity of plant and animal life in an advanced and permanent agriculture. These matters have all become very vital parts of our civilization and are becoming more so daily, as increasing population and greater complexity of civilization make us more dependent upon an intensive, highly specialized, and scientific agriculture.

So much for the aims and the work of the American Breeders Association. It has passed through the struggle of becoming an institution. It has brought together the genetic scientists and breeders. It has brought into the closest coöperative relations the breeders of plants, the breeders of animals, and those interested in eugenics. By a quiet policy of stating the results of research in eugenics it has overcome the opposition of an at first hostile press and of indifferent public opinion. It has thus been a powerful factor in compelling a respectful hearing for the science of eugenics and of genetics in general. It is recognized as already having rendered a large service, and its members believe it has further large and important functions to perform. Its scientific and philanthropic status is almost ideal. It is now ready for two things which alone can enable it to lead in the large service before it:

It needs endowment for its research work and it needs many more members as bearers of its educational work.

The man of research, the scientist, is on trial and is successfully demonstrating his usefulness. It is a characteristic of our modern science, that it fully recognizes its own importance. We are living in a time in which science is more and more applied to the affairs of man and to problems of public welfare. Persons with means could not find a more admirable group of people with whom to coöperate in putting forward enduring constructive work than the men and women of this Association. It is now so thoroughly organized and seasoned as to its field, its specific problems, and its methods, that its work should be recognized by persons who wish to invest money in truly vital service. In these days of large fortunes men and women seek to give in such manner that some large and permanent purpose is served which will do the most for human welfare and uplift. Scientific philanthropy has taken the place of scattered, indiscriminate charity.

Public and private money has been forthcoming from various sources for practical extension work in teaching, on a nation-wide scale, the facts of soil conservation and conservation of soil fertility. But owing to the peculiarity of research work in genetics and eugenics, the financial results are not always immediately in view, and in consequence public money is not usually so generously appropriated. Thus, much of the burden is borne by private individuals or the needed work is not done. Strange to say, the large live stock and herd book associations do not appropriate any money for research work. And in regard to that branch of genetics which concerns itself with eugenics, practically all research and educational work has been done under private agencies and with limited funds. Few as yet view eugenics in its broader aspect, namely; as a means of conserving the race through the preservation of family stocks of genius and leadership and exceptional ability, and the discovery and encouragement of capable and prepotent blood lines.

There is a much closer connection between genetics and the large social and public questions than the superficial student is aware of. The scientists who are doing research work in eugenics need the support of those who are in touch with the problems of charity and correction; and these, in equal measure, need to be in touch with those who are rapidly building up the science of eugenics. We have no public interest in which there is greater need of common sense based on experience and research.

It should appeal to each member of the Association as a personal duty to bring the work of this Association to the attention of his friends, particularly to the attention of persons who are in position

to assist this work with funds. There are hundreds of persons of wealth in this country who would be glad of an opportunity to advance a cause racially so important if only the facts in the matter were brought to their attention. The Association is officially in touch with only a comparatively small number of these people. Through its members it may reach many thousands. Let then each member feel it his personal duty to secure the interest and support of persons who are in position to endow the Association with large funds for carrying forward its work.

It is to be earnestly hoped that the next important foundation of historical note in scientific philanthropy will be made by some person or group of persons, to place genetics and eugenics in position to work out freely and in the fullest measure their logical tasks. Here is a work whose importance overshadows almost all else in human affairs, because it is basic of all permanent betterments; it concerns the race in its widest meaning and has to do with its very soul and life blood. From the endowment of this institution, the American Breeders Association, which is at once one of research and education, would date a period whose influence would give a permanent and new direction to the course of human affairs.

EUGENICS AT THE HYGIENE AND DEMOGRAPHY CONGRESS

That eugenics and sex hygiene have suddenly sprung into prominence was shown during three weeks in September at the International Congress on Hygiene and Demography in Washington. In a great exhibit, held in connection with the Congress in the Red Cross building, these subjects held a leading place. The officers of the National Federation of Sex Hygiene and of the Eugenics Section of the American Breeders Association boldly and very successfully carried on a campaign of education and publicity. At least, the tens of thousands of visitors at the exhibition and delegates to the Congress on Hygiene and Demography, and the people of Washington, have seriously accepted at face value the proposition that sex and eugenics matters are up for solution by scientific and educational methods.

The truly astounding fact about the entire eugenics and sex hygiene exhibit is that almost no controversy was aroused. The facts of sex diseases were driven home by means of graphic charts and reading charts and even by photographs and models in a most effective but unobjectionable way. That the annual cost of immorality and social diseases approximates three billion dollars out of a total of

thirty-four billion dollars, of our national production, makes one shudder. We are worse than playing with race making, we are rioting with nascent souls. A million and a quarter of infected women, who rightly blame men for their downfall, infect millions of men and through them probably millions of unblamable wives. Race morality and race hygiene are our greatest immediate national needs. Science, education and religion are ready to join in a mighty coöperation, in an energetic struggle against these devitalizing influences which tend to our undoing as a nation and a race.

The more pleasant and the ultimately more vital subject is race building. The Demography Congress clearly brought out the fact that we have 2 per cent of subnormal or abnormal children; or about two million people who are feeble-minded, or with a genetic tendency to insanity, immorality or criminality; and still others with a tendency to consumption or other organic weaknesses. It was also shown that some families of the nearly ninety millions of so-called normal people average high in efficiency while others rank low in their inherited ability to become useful citizens. The practicability for expert eugenists to assist young people in avoiding matings, in which a given weakness coming from both sides is certain to result in unfortunate children, was clearly stated by Drs. Davenport and Laughlin of the Eugenics Record Office, and is based upon their practical efforts at making scientific diagnosis on which people can base self-advice.

The Eugenics Record Office had about fifteen hundred square feet of wall space occupied by a display of very neat reading-charts and illustrations. This, together with the exhibit of sex hygiene, was perhaps the most intently studied exhibit in the entire building. No estimate has been made of the number of visitors to this eugenic exhibit. It is sufficient to say that the floor was much of the time crowded and that a large number of persons came with note-books and freely took notes from the charts.

A popular and interesting feature was the series of half-hour lectures on eugenics, in the special lecture room. These lectures or talks, some illustrated with charts and slides, were along popular lines, and were attended by intelligent audiences to the full capacity of the room. Dr. Chas. B. Davenport, Dr. H. H. Goddard, Dr. E. E. Southard, Dr. H. E. Jordan, Mr. Bleeker van Wagenen, Secretary, W. M. Hays, Mr. V. M. Cady, Mr. H. H. Laughlin, all members of the Association, had volunteered to fill the various lecture periods, so that three daily lectures could be given during the entire week. Mr. Cady of the Sex Hygiene Society, estimates the number of

attendants at the eugenics lectures at 3,000. The Association is greatly indebted to the gentlemen who donated their time and services.

BREEDING, GENETICS, EUGENICS

The dictionaries and common usage need to be brought closer together in the use of the words breeding, genetics and eugenics. As used in this *Magazine* and by the persons associated in the America can Breeders Association, these words have each come to have a definite meaning somewhat different from that assigned by the dictionaries. By Breeding is meant: That part of the production of plants and animals which relates to making varieties and breeds of a special type or of superior value, and extending the use of these values so that this blood may be used by other breeders. The word Genetics is accepted to mean: That branch of the science of living things which deals with their heredity and variation, and the breeding of plants, animals, and men. Eugenics, as defined by Galton, and generally accepted, means: "The science which deals with all influences that improve the inborn qualities of the race." That there is a divergence of definition and usage is shown by the fact that the 1910 edition of one of our leading dictionaries defines Eugenics as "The science of improving stock, whether human or animal, or of improving plants."

The international society devoted to the science of breeding has adopted the term Genetics as a part of its name—the International Society of Genetics—and some of its members, who are also members of the American Breeders Association, suggest that the name of this Association be changed to the American Genetics Association. This change has, in fact, been under consideration for some years among the members of this Association. This change would naturally carry with it the change of the name of this *Magazine* to American Genetics Magazine, American Journal of Genetics, or an equivalent name. When this Association was formed the name "Breeders" was the only commonly known name available. That name has been of great advantage in conveying to the public the practical purpose of the organization. On the other hand, it has been somewhat misleading, in that the public has always assigned it a restricted meaning, classing this organization and its publications with associations and publications which almost exclusively relate to the practical art and business of animal breeding.

Under the proposed change of name our association would enjoy a designation which would distinguish it entirely from all other breed-

ers associations, and our publications also would be distinguished from periodicals devoted mainly to the interests of the practical breeder. Some live-stock journals, which have felt that the *American Breeders Magazine* might become a rival, would then recognize its distinctive field under a name more clearly expressing the large purpose it is trying to fill.

The word "Genetics" would carry the broader meaning and would not be out of harmony with the present use of this term. The broader relation of the word genetics to the science of heredity, and breeding, and to the art of the improvement of the heredity of plants, animals, and man would be recognized. The word "Breeding" would be given its due prominence in the names of the Plant Section and the Animal Section, and the word "Eugenics" would be used in its restrictive sense in the name of the Eugenics Section. Workers, investigators and students could then be recognized by the following terms: Geneticists: those interested in a broad way in the entire field of the science of heredity and the art of breeding. Genetic Scientists: students and investigators of the theoretical aspects of heredity and breeding. Eugenists: those interested in the improvement of the heredity of the human species. Breeders: raisers and improvers of plants and animals. Plant Breeders: improvers and originators of varieties of plants. Animal Breeders: raisers and improvers of breeds of domesticated animals.

The word Thremmatology has also been somewhat in use, with a meaning nearly the same as given above for genetics. It would not be as convenient for general use as the latter word. For example, the name American Thremmatological Association would not make a convenient nor easily understood name. The word genetic, from the root word, gen, genea suggests the thought, to be born, as the word "eugenic" suggests the thought, to be well born.

The division of meanings outlined above for the words Genetics, Breeding, and Eugenics, has the advantage of simplicity, and of being easily understood by the laity, and of conforming closely with uses already common in the leading countries.

NEWS AND NOTES

GENETICS IN THE UNIVERSITY OF ILLINOIS

Professor John Detlefsen formerly connected with the Laboratory of Genetics, Bussey Institution, Harvard University, has been elected to the assistant professorship of genetics in the College of Agriculture of the University of Illinois, Champaign, Illinois. Professor Detlefsen will also fill the place of assistant chief in genetics in the Agricultural Experiment Station.

THE GIDEON MEMORIAL TABLET

The readers of the *American Breeders' Magazine* will be interested to know that the Native Sons of Minnesota have erected a tablet to

the memory of Peter M. Gideon, originator of the Wealthy apple. The tablet, which was unveiled by his daughter, was placed near where the original Wealthy tree stood, on the old Gideon homestead at Excelsior, Minnesota. The exact location of the original tree seems

to be in doubt; this would indicate that this act of recognition, in common with many others, was planned somewhat too late.

Among those assembled to witness the dedicatory exercises were many prominent in horticultural work as well as in the affairs of the state. There were a number of speeches in testimony of the services of Mr. Gideon to horticulture. A group of the older horticulturists present, who knew Mr. Gideon, and who saw the first apples exhibited from the original tree, seemed to link the present with the past.

Mr. Gideon really erected his own monument in 1864, when he planted the seed from which the Wealthy apple tree came, and the dedicatory exercises on June 15, 1912, only expressed in another manner the appreciation which many who grow and use the Wealthy apple have had, and still have for this man and his services to posterity.—M. J. DORSEY, *St. Anthony Park, St. Paul, Minnesota.*

SELECTION IN PURE LINES

One of the most pressing problems of today for the science of biology, as well as for the scientific plant-breeder, is to discover whether genetic factors are constant or are variable. This can probably be determined by experiment, if executed with the precision of the physical laboratory. The practical question is, whether selection can have any measurable effect when carried out in two opposite directions within a homozygous strain. Leguminous plants that are functionally cleistogamic (self-fertilized) seem to offer, in the dimensions of their dry seeds, suitable material for the experiment. Several sources of error, however, must be guarded against. Dry seeds measured in the spring, and again a month later, will sometimes be found to have shrunk perceptibly in the interim. The actual length of the dry seeds is also, in some strains, certainly determined by the amount of crowding in the pods.

The dimensions of a bean are maternal characteristics, and the only advantage of measuring more than one seed to each plant is to obtain an average which will be freer from the effects of "modifications." Now it seems that we should first reduce the modifications to as low a degree as possible. We can sometimes do this by taking our beans only from ripe pods of the average length and number of seeds, and by omitting the proximal and distal beans in strains of plants where these are often much smaller or larger respectively than the median beans. We should, I think, select in each generation those *plants* the average size of whose seeds is respectively highest or lowest.

Any seeds from each of these selected plants can then be grown, and the selection of plants continued for further generations. Each of the variates used in our work will then always be the mean dimensions of the typical beans of one individual plant.

If we mix at first all the beans of the plants of the homozygous strain, and then select the largest beans for one line and the smallest beans for another line, we shall, in some leguminous plants at least, be testing the distal beans of a pod against the proximal beans, and we may perhap find no effects from such selection, even after ten years. The separate beans of a leguminous plant are certainly not individuals with regard to their dimensions, but are only limbs or members of the zygote on which they grow. The great modifications in beans from different parts of the pod, and in pods with different numbers of seeds, will, in some leguminous plants at least, quite mask, for the purpose of selection, any small genetic differences which might or might not arise from variations of the individual genes.

It has been considered as proved, with *Phaseolus vulgaris*, that selection continued for several years produce no effect in different homozygous lines. But in these experiments, the separate beans, and not the individual plants, were selected.[a] Hence, I think that further search for a possible result of selection in pure lines (much less quantitatively than the immediate result of selection among the progeny of heterozygotes) will be useful.—JOHN BELLING, *Gainesville, Florida.*

KOREAN CATTLE

I have seen occasional specimens of Manchurian or Mongolian cattle that are good enough to catch the eye but the average specimen is a decided "Canner." Manchurian and Mongolian cattle are long horned, raw boned beasts that excite no admiration whatsoever. The Korean cattle on the other hand are magnificent specimens, resembling our Aberdeen Angus cattle very much. The Korean cattle are kept by the Koreans mainly for work purposes, being used in plowing the rice paddies, and in carrying freight to market on their backs or in heavy two-wheeled carts. They are commonly polled, black and sleek in color, with a tinge of Guernsey yellow or brown along the back. Some types are brownish yellow all over. The bulls attain large sizes, 1600 to 2000 pounds. The breed has less blockiness of type, less spring of rib and less compactness than our Aberdeen

[a] W. Johannsen, *Elemente der exakten Erblichkeitslehre*, pp. 113-157, Jena, 1909.

Angus breed. Taken as a whole though the breed is a magnificent one and doubtless under careful breeding management would fully equal any of our selected, domesticated breeds.—E. C. PARKER, *Johnson, Montana.*

PUBLICATIONS RECEIVED

EUGENICS. W. E. Neiberger, M.D., Bloomington, Ill. Pp. 7. Reprint from the *Clinique*, July, 1912, being a paper read before the Illinois Homeopathic Medical Association, May, 1912.

ANOTHER SEX-LIMITED CHARACTER. Edward N. Wentworth, Ames, Iowa. Reprinted from *Science*, June 28, 1912, page 936.

SOME DATA ON THE INHERITANCE OF HORNS IN SHEEP. T. R. Arkell. Bul. 160 of New Hampshire Agricultural Experiment Station, Durham, N. H. Pp. 35, 43 text-figures.

EVIDENCE OF ALTERNATIVE INHERITANCE IN THE F_2 GENERATIONS FROM CROSSES OF BOS INDICUS ON BOS TAURUS. Dr. Robert K. Nabours. Reprint from *American Naturalist*, 1912, pp. 428–436, 9 text-figures.

COÖPERATIVE COW TESTING ASSOCIATIONS IN MINNESOTA. Bulletin 1. Department of Agriculture, Albert Lea, State High School, Theo. Sexauer, Director, Albert Lea, Minn. Pp. 55, illustrated.

MENDELIAN INHERITANCE IN COTTON HYBRIDS. C. A. McLendon. Bulletin 99, Georgia Experiment Station, August, 1912. Pp. 141 to 228, 20 text-figures, 8 diagrams.

NATIONAL RESERVATIONS FOR THE PROTECTION OF WILD LIFE. T. S. Palmer. Circular 87, Bureau of Biological Survey, U. S. Department of Agriculture. Pp. 32, 5 text-figures (maps).

THE KALLIKAK FAMILY. H. H. Goddard. Pp. 121, fig. 14, charts 14. The Macmillan Company, New York, 1912, publishers. Price $1.50 net.

In this monograph, the eugenics movement is enriched by a substantial piece of literature. It is in line with the publications of research work issued by the Eugenics Record Office, being a contribution to more definite knowledge of a specific phase of human heredity. Dr. Goddard, who is an active member of the American Breeders Association is known to our members by his contributions and lecture work on the subject of feeblemindedness.

The author could not possibly have chosen a stronger and more convincing manner of presentation of the hereditary character of feeblemindedness. Such a story as this must strike home and attract public attention and arouse the public conscience. The book is an outline of a vast breeding experiment, extending over six generations, undertaken by the principals all unconsciously, but an experiment nevertheless as the scientist, who always controls and checks his work, could not have planned much better.

There are charted and recorded a total of 1146 individuals connected with this family. In one branch are recorded 41 matings, in which the parents were feebleminded persons, the offspring of these were 222 feebleminded and 2 normal. Another branch of the family has only normal individuals, and many of them of high physical and mental attainments.

We predict that this book will give the study of eugenics a strong impetus. The simplicity of the story, its appealing every-dayness and the warm human interest that fills its every page, make the book splendid reading for the layman and general reader. Dr. Goddard writes cautiously, he makes no attempts to draw generalizations. Suggestions in the way of "what is to be done" are made with the Doctor's characteristic reserve and carefulness.

The book is a primer of eugenics—anyone who can read, can understand it. It is a sermon—it drives home a lesson, the result of one thoughtless act. It is a demonstration of the effectiveness of modern methods of research as applied to human heredity. It is an unspoken appeal to other philanthropists, than the one who made this piece of research work possible, to support similar work in this new, marvelously productive and important field in the understanding of the human soul and human society.

The reflective person will receive from this little sketch new light on a large number of old problems. From it, the idea that many of our economic problems are at bottom biological ones, gains strong support. Dr. Goddard very correctly says:

> Such facts as those revealed by the Kallikak family drive us almost irresistibly to the conclusion that before we can settle our problems of criminality and pauperism and all the rest of the social problems that are taxing our time and money, the first and fundamental stop should be to decide upon the mental capacity of the persons who make up these groups. . . . . Thus it is, that if all the slum districts of our cities were removed tomorrow and model tenements built in their places, we would still have slums in a week's time, because we have these mentally defective people who can never be taught to live otherwise than as they have been living.

IS MANKIND ADVANCING? Mrs. John Martin. Pp. 302, numerous diagram tables. The Baker and Taylor Company, New York, 1910, publishers.

Mrs. Martin, who by the way is a life member of the Association, essays an answer to this question in a highly interesting and instructive book, which shows evidences of resourcefulness and a vast amount of library research work.

The broad inference to be drawn from this book, is that the present day race of the white man, as measured by morals, by religion, by general intelligence, by genius, by art, stands behind that of the ancient Greeks. That our civilization is below the level of the Ancients, not merely in many, but in most respects.

Although not prepared to agree with the author throughout, we are willing to admit that she presents an impartial analysis of our civilization. She is optimistic with faith in the eventual evolution of man. Note that the book is dedicated "to the super-man with the hope that his coming may not be too long delayed."

The question is put to our consciences whether we are more moral than the ancient Greeks; whether we can truly say that we are more honest, or more temperate, or chaste or just, or tolerant or hardy, or public spirited. Have we progressed in Democracy? do we hold life more precious? These questions are difficult to answer concisely; at best we can deal only in comparisons.

We are asked to judge man—homo—on his individual basis. We are asked to divest our minds of the idea that the accumulation of centuries in the way of knowledge, property, appliances, houses and other physical evidences as railroads, steamships, wireless, aeroplanes, skyscrapers, and so forth, represent our very own civilization. Man is not to be measured by the quantity of things he makes or by his wealth, or by the vastness of his undertakings, but by his own intrinsic worth.

Eugenics is recognized by Mrs. Martin as a possible factor of great moment, but she appears to lay greater stress upon environment as an evolutionary factor. The race must make a new start by providing a suitable "breeding ground for the coming super-man." Thus the exodus of woman from home activities in city and on farm into the industries, factories and shops is deplored. A strong plea is made for the farm as a breeding place for the race. "The state must recognize the human right of every child to be brought upon a farm," and Mrs. Martin advances numerous excellent euthenic reasons for this opinion.

The book is written in strong and vigorous style, becoming at times delicately and bitingly ironical. One feature especially, which commends it to the reader is the entire absence of dreary compilations of statistics, which at first thought one would expect in a book which, from its nature, must depend largely upon comparisons to carry its point. On the other hand, the glorification of the ancient Greeks in superlatives, detracts from, rather than adds, strength to the argument. The classicists, who have filled all literature with their exu-

berant appraisement of Greek culture, were largely governed by sentimental and poetical rather than by practical and scientific motives and Mrs. Martin has erred in accepting their dicta too literally.

The diagrams showing graphically the levels of attainments in various lines of human endeavor, during several centuries, should be more fully explained. This manner of presentation is open to criticism, as no explanation is given of the technique or method by which the various values were assigned.

The reading of this book is commended to legislators, congressmen and senators; teachers and educators and to eugenists in general.

REFERENCES IN CURRENT LITERATURE

THE SINGLE TESTING SYSTEM OF BREEDING FOR EGGS. D. F. Laurie, Department of Agriculture, Adelaide, South Australia. Pp. 14, text-figures 3.

Mr. D. F. Laurie, who is the Government expert and lecturer in South Australia, scarcely needs an introduction to the members of the Association. The interesting publication here named contains an outline of a system of breeding, and a method of housing that were used by Mr. Laurie in developing several distinct South Australian laying strains of poultry. The trap-nest is discarded and the single pen, 3 feet by 30 feet, with house 3 feet by 3 feet at end of pen, adapted. This breeder believes thoroughly in line breeding, because according to Mendel's law the proper course is to breed the various generations *inter se* until segregation is definitely assured. "Never breed from unsound or unfit and your work will proceed, but if one parent be unsound no amount of fresh blood will give any definite improvement."

A FRUIT BREEDING FARM IN MINNESOTA.

An article in *The Farmer*, St. Paul, Minnesota, Number of October 5, 1912, describes the fruit breeding farm, which is owned by the state of Minnesota and is located in that state. Dr. Chas. Haralson, for many years associated in plant breeding work with Prof. Niels Hansen of the South Dakota Agricultural College has been the superintendent of this interesting breeding farm ever since it began operations in 1907. The purpose of this institution is, of course, to originate new varieties of fruit, hardier and better than present varieties, and also adapted for a greater variety of special uses. The methods employed are those usually followed by plant breeders—selection and cross breeding. While this kind of work is naturally a long time proposition, the results obtained even in the short space of five years have

justified the wisdom of establishing this institution. At present, 6,000 cross-bred seedlings of apples, 6,000 of plums, 60,000 of strawberries, 13,000 of grapes, 10,000 of raspberries, and large numbers of cherries, apricots and peaches promise to turn in results in the shape of new commercial varieties. At any rate, this is a splendid foundation for a beginning. Hardy and desirable varieties of fruit trees and vines from all parts of the world are here brought together and by crossing new combinations of blood lines are made to form new varieties. Every state ought to have such an institution.

PROBLEMS IN EUGENICS. Containing the papers communicated to the First International Eugenics Congress, held at the University of London, July 24 to 30, 1912. Pp. 490. Published by the Eugenics Education Society, London, 1912. Price, 8/6 net.

This highly interesting publication is introduced by the presidential address before the congress, in which Mr. Leonard Darwin sounds the "keynote" of the Eugenics movement. The papers read and submitted at the congress are arranged under the sections of: I, Biology and Eugenics; II, Practical Eugenics; IIa, Education and Eugenics; III, Sociology and Eugenics; IV, Medicine and Eugenics.

The papers are printed in the language of the country in which they were originally prepared by their respective authors; many of the papers, however, have been translated into English. We note that of the papers contributed, 16 were originally in English, 9 in French, 5 in Italian and 2 in German. An additional volume of papers which were submitted too late to get into this volume, is promised.

THE INHERITANCE OF SKIN COLOR. Dr. H. E. Jordan, University of Virginia. Reprint from *Science*. August 2, 1912.

The writer expresses the opinion that skin color unquestionably is a Mendelian character. Segregation in the Mendelian sense takes place and there are records in mulatto offspring, cases of reversion, as well as cases of undoubted segregation of the white skin color in the third generation. This paper touches a large number of relevant topics, as for instance, the close histological resemblance of brunette and mulatto skins and the fact that protracted exposure to the sun will "tan" even very fair skin, causing an increase in the number of pigment granules in white skin. "Dark skinned races like the Italians and Spanish and finally the brunettes of the Anglo-Saxon race, may owe their pigmentation to negroid ancestry. The connecting link may well have been the negro slaves of Roman times, and the conquering Teutons."

STUDIES IN HUMAN HEREDITY. Dr. H. E. Jordan. Bulletin of the Philosophical Society of the University of Virginia. Pp. 293 to 317, illustrated by numerous heredity charts. Price, 40 cents.

Investigations by the author, into the heredity of left-handedness have incidentally brought to light other characters which seem to show hereditary tendencies. Among those are tuberculosis, cancer, hermaphroditism, onyxis, nephritis, melancholia and thumb-prints. Dr. Jordan holds, that "if pathologic conditions are determined even in part by hereditary constitutional bases, then methods looking to permanent racial cure, i.e., complete eradication, must reckon more intelligently and widely with the hereditary aspect of disease."

ETHNIC CENSUS IN MINNEAPOLIS. Prof. Albert E. Jenks. *American Journal of Sociology*, May 1912.

Professor Jenks discusses the "forces of ethnic cohesion and amalgamation" on the basis of an ethnic census recently made in Minneapolis and embracing 80,000 heads of families. This article is in the nature of a preliminary report; the deductions given are drawn from that part of the material which have been digested to date.

For the first time perhaps, we are enabled through the data furnished by this census taken in a city with a large and diverse foreign population to gain a fair idea not only of the rate of amalgamation taking place in a large city, but of the diverse elements which enter into it. These preliminary statements suggest that the blood mixture coming under the observation of this census is complete, ethnic (racial) lines being totally obliterated. To quote Prof. Jenks:

> Of the slightly less than 80,000 heads of families whom we have under consideration, not one pure-blood individual of the fourth generation American birth has been found who has married with another pure-blood person of his own people, no matter what the generation of this second individual may have been. In other words the force of ethnic cohesion has broken down completely after the third generation of American birth, and the amalgamation process is then given full rein. This is true of the 80,000 heads of families coming originally from 37 distinctive people whom our investigation has found in Minneapolis, and, strange as it may seem, it is as true of the Jew as of the other.

The effects of crossing on fecundity of families are of decided interest. Some combinations as pure Irish with pure Irish are more fecund than Irish with Scandinavian; the latter tending to pull down the degree of fecundity. We incline to the opinion that these fecundity data will need to be handled with extreme caution as the classification of individuals in the census is based, not on ethnic but on geographic (nationality) distinctions.

ASSOCIATION MATTERS

AN APPEAL

Members who are in arrears for their 1911 or for 1912 membership dues are respectfully requested to settle, so that all funds coming from this source may be available before the close of the year. The Association has been to rather more than usual expense in the printing of the combined annual reports VII and VIII. Increased cost of material and printing, as well as an unusually large amount of complicated typographical work, has made this volume more expensive than any two preceding numbers. The Council of the Association hopes that its efforts will be appreciated by the membership at large, and that the outstanding annual dues for 1912 will be sent with promptness. The total of this amounts to a considerable sum and it will go far toward enabling us to meet our obligations.

The price of Volume VII–VIII has been fixed at $3 and members are asked to assist in finding sale for single copies to libraries and non-members.

ELECTION OF LIFE AND DELEGATE MEMBERS DURING THE PAST QUARTER

Mr. E. A. McIlhenny, Avery Island, Louisiana; Norges Landeruksheiskole, Foringsforsoksstationen, Norway; Johns Hopkins University, Baltimore, Maryland; State Normal and Industrial College, Greensboro, North Carolina; Canadian Medical Association, Montreal, Canada; Hamilton Public Library, Hamilton, Ontario, Canada; Mrs. Aaron M. Wilcox, Baltimore, Maryland.

REDUCED RATES TO THE MEETING OF THE AMERICAN BREEDERS ASSOCIATION

The secretary of the National Corn Exposition, Mr. George Stephenson, announces that he has secured reduced fares in the territory of the South Eastern Passenger Association, for persons intending to attend the Corn Exposition and the Annual Meeting of the American Breeders Association. The selling date of these tickets begins January 20. It is possible that several of the other passenger associations will grant reduced rates also. In the event that they do not, however, visitors from territory outside should purchase tickets to some point within the territory of the South Eastern Passenger Association, say Washington, D. C., Cincinnati, Louisville, Memphis, St.

Louis or New Orleans and from there take advantage of the excursion fares which amount to just about one-half of the regular fare.

On the 24th and 25th the meetings of the American Breeders Association will be confined to the regular sessions. On Monday the 27th, the members will visit the exposition on its opening day. On January 26, the visiting members of the Association, together with all men at the exposition in connection with the educational exhibits, will be taken for a pleasure trip to Charleston, as the guests of the Southern Railroad and the Charleston Chamber of Commerce. A brief visit will be made to the Drainland Experiment Station; thence to Summerville where the visitors will be shown the only tea farm in the United States, and last, but most interesting of all, will be the visit to the quaint old city of Charleston, where all will be entertained by the Chamber of Commerce. Among the features planned for the entertainment is a visit to the points of scenic and historical interest about the city; a harbor trip taking in the Navy Yard, Fort Sumter and Fort Moultrie, and a clam-bake on the Isle of Palms. The secretary of Charleston Chamber of Commerce writes: "You may rest assured that to the members of the American Breeders Association the day at Drainland, Summerville and Charleston will be the time of their lives." Charleston hospitality will be on tap. The American Breeders Association will have a booth in the exposition for its headquarters, also an exhibit and will have use of a lecture room where lectures and talks may be illustrated by lantern slides if desired.

The Association is especially appreciative of the work, along various lines, of Mrs. Aaron M. Wilcox of Washington, D. C. Mrs. Wilcox, who is a life member of the Association, has presented delegate memberships to the Canadian Medical Association, to the Public Library at Hamilton, Ontario, Canada. The last of these she gave in honor of her son the late Horace W. Wilcox who resided at Hamilton, Ontario. Mrs. Wilcox has also presented a delegate membership to Johns Hopkins University, at Baltimore, Maryland.